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Empirical Assessments of Financial interdependencies since the 1970s

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Empirical Assessments of Financial interdependencies since the 1970s

Benjamin Peeters

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in fulfillment of the requirements for the Doctoral Program in Economics and
Management.

Summary

With both trade and financial globalization on the rise, the main objective of this thesis is to assess whether financial interdependencies today are different from those in the past decades and whether such differences can be attributed to economic globalization. Especially, this study focuses on the impacts of medium-term cycles in center economies on short-term international financial flows to semi-periphery economies and the evolution of international monetary policy spillovers.

This thesis is composed of three core chapters. The first proposes a portfolio optimization model to document the conditions and hypotheses under which financial flows to semi-periphery are procyclical or countercyclical to macroeconomic medium-term cycles in center economies. An empirical identification strategy is derived from the model. The findings indicate that financial flows to semi-periphery countries are countercyclical to these cycles for portfolio investments (in contrast to FDIs and portfolio investments to periphery countries). This suggests that portfolio investors shift part of their investments from center to semi-periphery economies during periods of lower returns in center economies, and vice versa.

The second chapter complements the first. The study explains how macroeconomic medium-term cycles in center economies trigger countercyclical financial flows to semi-periphery countries that subsequently induce balance-of-payment crises in these economies. A review of crisis episodes in semi-periphery countries since the 1970s confirms the model. It highlights that the last three waves of crises that affected semi-periphery economies are each linked with the medium-term cycles in center economies and disruptive international financial flows.

Lastly, this study examines the evolution of international monetary policy spillovers. The findings indicate that these spillovers are sizable and have increased considerably since the 1980s. By exploiting a method to disentangle the evolution of spillovers driven by economic integration from those driven by changes in how countries react to foreign factors, it is shown that globalization is an important driver of these spillovers. This study also documents that the influence of the United States reached a peak around 2008 and supports the existence of multipolar interactions.

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List of Acronyms and Abbreviations

ASEAN Association of Southeast Asian Nations. 16, 128, 302, 315

BIS Bank for International Settlements. 61, 63, 122, 157, 162, 185, 265, 330

BoE Bank of England. 40, 153, 173, 194, 378, 385, 386

BOJ Bank of Japan; Nippon Ginkō. 40, 173, 194, 378, 385, 386

BOP crisis balance-of-payment financial crisis. xi, 42, 43, 97–99, 105, 107, 112–114, 124, 125, 129, 131–133, 135, 137, 139, 148–150, 206, 207, 317–320

BRICS Brazil, Russia, India, China, and South Africa. 13

CCPIT China Council for the Promotion of International Trade. 322

CLIF cycle Center Leader economies' Industrial-Financial cycle. xi, 22, 23, 28, 29, 42, 43, 45–48, 50–59, 62, 63, 65–72, 74–81, 84–90, 92–95, 97–99, 102–107, 112, 114, 115, 124, 125, 133, 134, 136, 137, 148, 149, 202, 203, 206, 207, 211, 212, 250–254, 256, 259–262, 264–267, 275, 277–279, 281, 284, 286, 300, 301, 304–311, 317, 318, 324, 328, 329

COVID-19 Coronavirus disease 2019 – with scientific name SARS-CoV-2. 1, 40, 211, 212

CPI consumer price index. 61, 63

DGP data generating process. xi, xv, 56–58, 68, 69, 77, 78, 80, 81, 83–86, 88–91, 93, 158, 160, 163, 167, 186, 262–264, 280–288, 344, 351–354, 368

EBRD European Bank for Reconstruction and Development. 302

ECB European Central Bank. 32, 40, 136, 153, 157, 173, 174, 194, 208, 378, 385–387

ECLAC Economic Commission for Latin America and the Caribbean (also known as UNECLAC or CEPAL). 322

EPA Economic Partnership Agreement. 16, 302

ESCB European System of Central Banks. 16, 17, 27, 40

EU European Union. 16, 17, 27, 57, 129, 135, 139, 145, 299, 302, 313, 315, 318–320

FDI foreign direct investment. v, xv, 16, 42, 45, 48, 63, 64, 88, 89, 92, 94, 96, 100, 101, 108, 112, 113, 117, 118, 123, 126–129, 132, 134, 142, 162, 185, 204, 207, 264, 276, 286–288, 297, 298, 302, 312–315, 318, 327, 374–376

Fed Federal Reserve system. 8, 31, 32, 40, 43, 115, 116, 120, 125, 126, 136, 142, 146, 152, 153, 155, 173, 174, 188–190, 192–194, 197–199, 207–210, 312, 317, 378, 385–387

FRED Federal Reserve Economic Data – Federal Reserve Bank of Saint-Louis (website). 61, 63

FTA Free Trade Agreement. 17, 302, 315

GATT General Agreement on Tariffs and Trade. 302

GCF Gross Capital Formation. xi, xii, 25, 28, 60, 61, 71, 206, 265, 268–271, 278

GDP Gross Domestic Product. xiii, 12, 13, 20, 24, 25, 28, 31, 47, 57, 61–63, 65, 66, 68, 69, 71, 83, 108, 112, 115, 117, 123, 125, 128, 130, 133, 135, 136, 141, 144, 148, 193, 264–266, 278, 280, 281, 289, 303, 304

GFC Global Financial Crisis. 13, 19, 22, 23, 26, 31, 32, 40, 43, 62, 95, 100, 105, 113, 114, 133–142, 145, 146, 155–157, 171–173, 178, 180, 182, 190, 191, 193, 194, 197–199, 207, 210, 211, 267, 276, 298, 314, 316–318, 320–322, 325, 328–330, 367, 370, 371, 386, 387

GKO abbreviation of 'Government Short-Term Commitments' in Russian. They are short-term zero-coupon government bonds issued by the Russian Finance Ministry. 124

GNI Gross National Income. 12, 13

IDS International Debt Statistics. 12, 63, 81–83, 87

IMF International Monetary Fund. xv, 13, 14, 27, 40, 63, 64, 115, 122, 123, 125, 129, 130, 133, 135, 136, 144, 275, 293, 302, 314, 315, 320, 328

IPN International Production Network. 4, 15–17, 27, 30, 32, 33, 39, 100, 106, 113, 118, 126–128, 132, 207, 298, 302, 312, 315

ISI Import Substitution Industrialization. 110, 117, 119, 120, 123, 176

LDCs least developed countries. 12, 13

LIBOR London Inter-bank Offered Rate. 117

LKSR local kernel spatial regression. x, xiii, 166–171, 173, 180, 185, 198, 209, 213, 358, 366, 367, 369–374, 381, 382, 385

M&A merger and acquisition. 297

MENA Middle Eastern and North African. 179–181

METI Ministry of Economy Trade & Industry. 61, 63

ML maximum likelihood. 160, 167, 187, 195, 209, 363, 368, 369

MNE Multinational Enterprise. 15, 16, 27, 40, 100, 106, 118, 127, 129, 140, 201, 297, 298, 312, 313, 315

NAFTA North American Free Trade Agreement. 16, 17, 125, 126, 299, 302, 313, 315

NBER National Bureau of Economic Research. 185, 374

ODA Official Development Assistance - indicator used by the OECD to measure foreign aid. 123, 128, 302, 312

OECD Organization for Economic Co-operation and Development. 61, 63, 65, 157, 265

OPEC Organization of the Petroleum Exporting Countries. 116, 117, 145, 326

PIGS Portugal, Italy, Greece, and Spain. 13

PPG public and publicly guaranteed. 63, 82, 83

PPP purchasing power parity. 13, 63, 66, 71, 278

R&D Research and development (also known in Europe as research and technological development namely RTD). 105, 112

REER real effective exchange rate. 57, 109–111, 130, 142, 144, 313, 324

S5 five systemic economies, comprising China, the Euro Area, Japan, the United Kingdom, and the United States. 14

SAP Structural Adjustment Program. 122, 123, 133, 299, 302, 314

SDR Special Drawing Rights. 328

SDSR score-driven spatial regression. xiii, 166, 169, 366, 367, 369–373

SOE State-Owned Enterprise. 100, 101, 106, 119, 140, 143, 299, 302, 313, 315, 322, 323

TCM Transmission channel matrix (also known as spatial weighting matrix). 63, 74, 77–87, 94, 214, 264

TRIM Trade-Related Investment Measure. 315

TRIP Trade-Related Aspects of Intellectual Property Right. 315

UK United Kingdom of Great Britain and Northern Ireland. xi, xii, 17, 21, 47, 59–62, 124, 129, 137, 157, 158, 177, 183, 204, 265–267, 269, 290, 291, 333, 342, 343

UN United Nations. 12, 63, 65, 82, 161, 374

UNCTAD United Nations Conference on Trade and Development. 13

US United States of the America. v, xi, xii, 8, 12, 15, 17, 19, 21, 22, 24, 26, 30, 31, 34, 36, 38–40, 46, 47, 57, 59–63, 67, 68, 75, 76, 82, 102, 112–116, 118, 119, 121, 124–127, 129, 130, 132–138, 142, 143, 145–148, 155–158, 181, 183, 185, 186, 188–194, 196–199, 204, 207–210, 265–267, 277, 278, 290, 291, 302, 311–315, 317, 319–321, 323, 328–330, 333, 343, 349, 357, 358, 385, 386

USD United States dollar. 116, 133, 141, 143, 144, 193, 320, 329

USSR Union of Soviet Socialist Republics. 22, 95, 114, 119, 126, 127, 179, 207, 300, 309, 311, 313, 315

VAR vector autoregression. 31, 153, 173, 186, 208

WTO World Trade Organization. 27, 104, 127, 176, 302, 315, 324, 325

WWII World War II. 6, 12, 22

1 | Introduction

Economic globalization – that is the rise of integration and interconnection of commodity and financial markets – has been recognized as a major force around the world for at least five decades. Television specials, newspapers, social media platforms, political discourses, as well as academic journals in economics and other fields have been considerably influenced by globalization's impacts. Recent events — from the several supply chain disruptions caused by the Coronavirus disease 2019 (COVID-19) pandemic, the peaks and plunges in energy and commodity prices, the worldwide high inflation rates to the bankruptcy of Evergrande in China, the rising public debts, the blocking of the Suez canal by the Ever Given (just to name a few) — have shown how the global economy has been deeply interconnected. Economic globalization seems to have become ubiquitous. Although for several prominent academic and public figures globalization has been an obvious good force – sometimes attributing alternative views to anger or misinformation –, important and (sometimes) fruitful debates persist in our society.[1] Among the general public, various groups have proposed very different economic, political and historical interpretations of the nature and impacts of globalization. In addition, well-recognized economists have presented much more balanced, if not negative, interpretations of globalization – in particular regarding the impacts of financial globalization.[2]

Although the topic of globalization has been documented by plenty of rich studies,

[1] As an illustration, Bordo et al. (2007) state that "for most [globalization] is a good force, but for a very angry minority it appears to be a bad force."

[2] For instance, Rodrik and Subramanian (2009) argue that "the effect of foreign finance is often to aggravate [the] investment constraint by appreciating the real exchange rate and reducing profitability and investment opportunities in the traded goods sector, which have adverse long-run growth consequences" and that "[i]t is time for a new paradigm on financial globalization, and one that recognizes that more is not necessarily better." More recently, see also Stiglitz (2017). Interestingly, Caprio (2012) state that "[f]inancial openness and globalization can bring both potential gains and risks. There is more debate among economists questioning the gains from financial openness, or integration into world capital markets, than there is about the gains from open trade."

a vibrant academic literature still debates vigorously the extent and nature of certain features of modern economic globalization, with important policy and political implications. As an illustration, recent publications opened an important debate about the continuing validity of the Mundell trilemma (e.g., Rey, 2015; Passari and Rey, 2015).[3] Does the emergence of global financial cycles reduce the effectiveness of floating exchange rate regimes in isolating the domestic economy against financial pressures as suggested by Han and Wei (2018) and Ligonniere (2018)? Likewise, the issue of the impact of economic globalization on the transmission of monetary policy has been debated since the development of the Euromarkets in the 1960s and 1970s (Helleiner, 1994; Burn, 2006). Key questions include: Has financial and trade globalization deteriorated the monetary policy effectiveness of central banks by its impacts on the interest rate channel, wealth effect channel, and international monetary spillovers as documented in various studies (Cetorelli and Goldberg, 2012; Mehrotra et al., 2019; Breitenlechner et al., 2021)? Or is it possible that globalization has actually strengthened the transmission of monetary policy by reinforcing the exchange rate channel as claimed by Georgiadis and Mehl (2016)? In addition, many findings have provided insights on the trends and dynamics in international financial flows (BIS, 2021). Yet a few key questions remain open. Has the impact of global cycles been marginal on financial flows as in Cerutti et al. (2019) or considerable and detrimental for stability and monetary autonomy as discussed in Jain-Chandra and Unsal (2014) and Miranda-Agrippino and Rey (2015)? Is the root of financial crises to be found in domestic policies (e.g., Ghosh et al., 2016) or international factors (e.g., Accominotti and Eichengreen, 2016)? This study aims at contributing to the vast literature on the impact of globalization by providing some empirical highlights on the influence of economic globalization on financial interdependencies.

This introduction starts by clarifying the concept of economic globalization. The re-

[3] In its simplest formulation, the Mundell trilemma – also called 'impossible trinity' – states that a country (or a set of countries belonging to a monetary union) can only pursue two of the following three goals simultaneously: (i) significant capital mobility (i.e. absence of capital controls), (ii) autonomous monetary policy, and (iii) fixed foreign exchange rate. For instance, in absence of capital controls, the monetary policy of a country is no longer autonomous if it chooses to peg its currency (as it was the case for various countries in the Bretton Woods' period).

search question is then detailed and follow by a description of key concepts (financial crises, center-periphery, etc.) As a key illustration of the importance of financial interdependencies on policy implementation, a review of the literature on the influence of globalization on monetary policy and the contributions of the different chapters in that regard is discussed in Section 1.3. Finally, the chapters composing this thesis are briefly described in Section 1.4.

1.1 Economic globalization

Throughout this study, if not specified otherwise, the concept of globalization is used to refer to the recent economic globalization, that is the rising integration and interconnection of commodity and capital markets since the 1970s. Rightly, some readers could contest this choice for at least three major reasons. First, it could be argued that other dimensions of globalization – which are conceivably not directly economic, yet very important - are overlooked. For example, sociological and cultural transformations have been intertwined with economic globalization. Worldwide transmissions of diseases are other illustrations. Directly related to the topic of this contribution, the constitution of a global epistemic community of central bankers has definitively impacted the implementation of monetary policies these last decades. Second, this choice overlooks some important components of economic globalization. Importantly, economic globalization as a full concept should incorporate a dimension of interconnection and integration of labor markets, worldwide transfer of technologies and innovations, international migrations, and demographic transformations. Third, considering globalization as a set of phenomena starting in the 1970s consists in adopting a very narrow historical perspective. Adopting a very long-term viewpoint, the beginning of globalization can arguably be dated to the origin of our species as a global migration process, that is the Great Dispersal.[4] More directly

[4]For example, Sachs (2020) documents a series of seven distinct worldwide waves of technological and institutional change, called waves or ages of globalization, starting with the original settling of the planet by early modern humans through long-distance migration and ending with reflections on today's global economy.

connected to the subject of this research, it is important to mention that, from a financial and trade perspective, the economic globalization discussed in this thesis is (at least) the second long wave of modern globalization, the first being the large economic integration and interconnection of the global economy between the 1820s and 1914 (Bordo et al., 2007; Calomiris and Neal, 2013).[5] Although all these points have strong foundations, the richness of modern economic literature requires to narrow the breadth of the perspective to dive deeper into the economic implications.

Definition 1.1. *Economic globalization refers to the rising global integration and interconnection of commodity and capital markets since the 1970s.*

Economic globalization can be separated into two crucial components. First, financial globalization broadly means (i) the generalized removal of capital and foreign exchange rate controls that started in the 1970s in center economies, (ii) the creation of interconnected and integrated global financial markets, initiated by the development of the Euromarkets, and (iii) the development of an international banking sector. Second, trade globalization has been characterized by (i) the internationalization of the industrial processes and the constitution of International Production Networks (IPNs) and global value chains, (ii) the rising share of the world production that crosses international boundaries, (iii) the decline in transportation and communication costs, (iv) the generalization of greater trade openness and decrease in trade barriers.

1.2 Research question and key concepts

With both trade and financial globalization on the rise these last decades (e.g., see Quinn, 2003; Bordo et al., 2007; Dreher et al., 2008; Cassis et al., 2016; Gygli et al., 2019; BIS, 2021), the main goal of this study is to empirically assess whether the degree and nature of financial interdependencies are different from those in the past (e.g., during the Bretton Woods era or under the Gold Standard) and whether such differences can

[5]In this context, the topic of this thesis is the analysis of the impacts of the *second* globalization on monetary interdependencies.

be linked to globalization. Specifically, the main research question of this study can be formulated as follows: *Have financial and monetary interdependencies increased in recent decades as a result of economic globalization?* This study supports an affirmative answer by empirically documenting the influence of the medium-term macroeconomic cycles in center economies on international financial flows to semi-periphery countries and on waves of financial crises affecting these economies as well as by providing evidence of increasing international monetary policy spillovers.[6]

In this research, an interdependence is considered as existing when a unilateral policy or macroeconomic change in one country inflicts harm on, provides benefits to, or requires a policy adjustment by at least another country.[7] The nature (that is the existence, significance, and dynamics) and the scale (the magnitude of the impacts) of the interdependence are defining characteristics. Common financial interdependencies include the macroeconomic impacts resulting from devaluation, rising inflation, changes in monetary policy stance, and capital control.[8] These interdependencies are particularly impactful when they originate from "systemically-important" economies. Notably, significant financial flows and capital mobility are the most important factors at the root of these financial interdependencies. Regarding the influence of economic globalization on financial interdependences, this study focuses on sizeable center and semi-periphery economies, leaving aside in most cases both periphery economies, that is to say the poorest countries (e.g., the Central African Republic, Afghanistan, or Yemen), and very small countries or inhabited dependent territories (e.g., the Cayman Islands, Bahamas, or Niue). Therefore, most of the analyzed economies have been financially integrated to the global economy. This research concentrates on recent trade and financial globalization and its medium-term effects on international financial flows, financial crises, and monetary interdependencies. The following paragraphs explain these key concepts.

[6] The concepts of center, semi-periphery and periphery countries are based on their role in the international division of labor and global value chains, with center countries capturing the largest share of global added value per capita (see details below).

[7] In that regard, competitive protectionism or sea and air pollution beyond national borders are regarded as interdependencies.

[8] No distinction is made between interdependencies, contagions and spillovers in this introduction.

1.2.1 Financial crises

Several types of financial crises have been identified in the literature.[9] Based on quantitative thresholds, inflation crises are defined as sustained periods of high inflation (e.g., a twelve-month inflation threshold of 40 percent or higher for the post-World War II (WWII) period). Likewise, currency crises can be defined as large and abrupt exchange rate depreciations (e.g., 25 percent per annum in Frankel and Rose, 1996). Other definitions of financial crises can be based on specific events. External and domestic debt crises are the repeated failures by a government to meet (principal or interest) payments within a specified grace period leading to a default or rescheduling of the debt. Likewise, the start of a banking crisis corresponds to the moment of either a bank run that lead to closure, merging or takeover by the public sector or the closure, merging, or takeover itself.[10] Although these distinctions are fruitful for various reasons,[11] three important considerations must be highlighted. Firstly, different varieties of crises commonly emerge as "economic" clusters (e.g., twin crises refer to simultaneous banking and currency crises.), suggesting that it might be possible (at least in principle) to have a more systemic definition of financial crises. An example of such attempts, based on agency theory, consists in defining a financial crisis as a period "when information flows in financial markets experience a particularly large disruption, with the result that financial frictions and credit spreads increase sharply and financial markets stop functioning" (Mishkin and Eakins, 2016). Secondly, financial crises tend to fall in "spatio-temporal" clusters, pointing that these events are likely to be deeply interconnected in time and space (as noted in Calvo et al., 2004; Aliber and Kindleberger, 2017). The Third World Debt Crisis of the 1980s or the financial crises in South East Asia of the 1990s are two common examples. Interest-

[9] Interested readers can refer to Reinhart and Rogoff (2009) and Caprio (2012) for two in-depth overviews.

[10] Banking crises can also be dated quantitatively using time series data (along the lines of inflation or currency crises). For example, abrupt changes in bank deposits or the relative price of bank stocks can be used as quantitative proxies. Yet, this approach is only possible for center economies in the recent decades due to data limitations.

[11] Notably, these definitions are simpler and often more transparent delineations of crisis episodes than broader or holistic definitions, which ease formal comparisons across countries and time (Reinhart and Rogoff, 2009).

ingly, the existence of "economic" clusters is often linked to these socio-spatio-temporal components. For example, as its name suggests, the Third World Debt Crisis corresponds to a cluster, or wave, of external debt crises in poorer economies that originated in the early 1980s. Thirdly, detrimental disruptions in the financial sector (i.e., financial crises) defined by these conventional perspectives are differentiated based on the financial indicators used to assess these "crisis states." In other words, in many cases, the categories rely on the observable and measurable characteristics of their impacts on the affected economies. Their economic consequence defines their nature. As a result, the underlying reasons for such events are put in the background. To emphasize the importance of foreign financial influence as a driving force of these crisis episodes and their clustering nature, this study mainly refers to financial crises as large balance-of-payment disruptions caused by reversals in international financial flows.

Numerous studies have well documented the long-term correspondence between the periods of high global capital mobility and financial crisis episodes since the Napoleonic Wars (e.g., Obstfeld and Taylor, 2005; Bordo et al., 2007; Reinhart and Rogoff, 2009). Likewise, for the period after 1970, numerous studies have presented evidence of the association – supporting a causal interpretation – between episodes of financial liberalization and financial crises (e.g., Detragiache and Demirgüç-Kunt, 1998; Drees and Pazarbasioglu, 1998; Kaminsky and Reinhart, 1999; Chang et al., 2001; Jonung et al., 2009; Khan et al., 2014; Park et al., 2021). Strikingly, most financial liberalization processes of the 1980s and 1990s were linked with financial crises, in center as well as semi-periphery economies – with only a few exceptions of smooth liberalizations (e.g., Canada). Therefore, it comes as no surprise that the most conventional and commonly highlighted of the risks associated with the process of globalization is the rising occurrence and intensity of financial crises (Obstfeld and Taylor, 2005; Caprio, 2012; Aliber and Kindleberger, 2017; Eichengreen, 2019b).[12] Chapter 3 provides empirical evidence supporting that numerous financial crises

[12]Two other commonly discussed problems linked to the development of supranational capital markets in the economic literature are (i) the enforcement of contracts and asymmetric information challenges, and (ii) the loss of fiscal and monetary policy autonomy. The literature on influence of financial globalization on monetary policy autonomy is briefly discussed in Section 1.3.

in semi-periphery countries are (partially) caused by large medium-term cycles in center countries that have been accentuated by financial liberalization of their economies (see Borio, 2014; Jordà et al., 2017). In this context, the evolution of international financial flows is regarded as crucial to understand these episodes of "sudden stops" and the risks linked to financial globalization.[13]

1.2.2 Monetary interdependence

A monetary policy interdependence is viewed as a financial interdependence which alters the conduct and/or efficiency of monetary policy of at least one country. Two categories of monetary interdependencies can be distinguished. On the one hand, monetary interdependencies can originate from changes in monetary policy. In this case, an initial change in monetary policy stance by a central bank affects the conduct or efficiency of another central bank's monetary policy. For example, a more stringent monetary policy by the Federal Reserve system (Fed) will likely lead to an increase in the policy interest rate of the National Bank of Panama as this country currently peg its exchange rate to the US dollar. All other things being equal, if Panama's central bank chose not to react, financial flows would leave the country and the exchange rate would change. Chapter 4 concentrates on this first type of monetary interdependencies and their evolution since the 1980s. On the other hand, monetary interdependencies can emerge from other factors. Macroeconomic changes in a country can lead to a contagion effect affecting the monetary policy of another economy. For example, the burst of a bubble in a sizeable economy will likely impact the neighboring countries.[14] Under these circumstances, financial flows will move across the borders and will ultimately reshape the financial conditions of the countries involved. In this study, Chapters 2 and 3 focus on this type of monetary interdependencies, and in particular the impact of medium-term industrial and financial cycles

[13] Likewise, Chapter 2 supports this analysis by providing statistical evidence of a countercyclical pattern between international short-term financial flows to semi-periphery economies and the medium-term cycles in center economies.

[14] This statement itself by no means suggests that the monetary policies implemented by the country experiencing the financial difficulties will not interact and alter the effect of the crisis on other economies.

(see below). It is worth noting that, as the two examples illustrate, significant financial flows and free capital movements are key contributors to many (if not all) monetary interdependencies. This is why this study focuses on the post-Bretton Woods era (1970s to the present), that is a period that has been characterized by much freer financial flows. This is also the reason why Chapters 2 and 3 study changes in international financial flows.

The degree of monetary policy autonomy of a country describes both the level of freedom in the conduct of monetary policy and to the absence of external influence on the monetary policy transmission channels. On the one side, a central bank or monetary authority can exercise an autonomous monetary policy if neither its decisions nor its implementations are affected by external factors. For example, a large degree of autonomy in the conduct of monetary policy implies that central banks can decide their level of monetary policy interest rates based on domestic needs and free of external political and economic interference. Central banking cooperation agreements that orient the timing, nature and/or magnitude of certain monetary policies are direct examples of factors limiting the autonomy of the conduct of monetary policy. Adjustments in the monetary policy stance caused by external monetary policies, such as a new macroprudential policy or a rise in interest rates in a foreign country, illustrate a constrained conduct of monetary policy. On the other side, the degree of the monetary autonomy also refers to the efficiency of the transmission channels of monetary policy. In that regard, monetary policy transmission describes how changes in central banks' monetary policy flow through the economy and impact economic activity, credit creation, and inflation. Monetary policy influences these macroeconomic variables through various monetary policy transmission channels (e.g., see Mishkin, 1996; BIS, 2008; Boivin et al., 2010; Ireland, 2010; Mishra et al., 2010; Rehman, 2015): banking lending channel, asset prices and wealth channel, exchange rate channel, cost channel, balance-sheet channel, etc.[15] The efficiency of monetary policy crucially depends on the efficiency of these transmission channels. A rich academic literature

[15]These monetary policy transmission channels are briefly explained in Section 1.3.2.

documented how economic globalization has considerably affected several of the involved mechanisms (see Section 1.3).

This study contributes to the literature on the impacts of economic globalization on monetary autonomy in two different ways. Firstly, Chapters 2 and 3 propose to indirectly assess a dimension of monetary policy autonomy for semi-periphery countries. These studies provide evidence that macroeconomic medium-term cycles in center countries are significant drivers of financial inflows to and affect the occurrence of financial crises in semi-periphery countries. Therefore, supported by various studies addressing the links between monetary autonomy and financial flows and crises (e.g., Grabel, 1996; Mishkin, 1996; Gabor, 2012; Caprio, 2012; Jain-Chandra and Unsal, 2014), these findings suggest that medium-term cycles in center economies have weakened the monetary transmission mechanisms in semi-periphery economies. Secondly, this is achieved in Chapter 4 by analysing the conduct of the monetary policy interest rates. This chapter documents the existence of sizable international monetary policy interest rate spillovers across monetary areas that have risen considerably since the 1980s. Crucially the findings suggest that economic globalization between economies has played an important role as a driver of this upward trend in monetary interdependence.

1.2.3 Center leader and semi-periphery economies

I describe here the concepts of center, semi-periphery, and periphery countries, and then those of leader and follower countries.[16] This framework is particularly important for Chapters 2 and 3 and is used to define categories to sparsely model the financial influence of some countries on others. I first briefly overview some influential economic classification systems used to analyze the global economy. Then, I define the concepts of center, semi-periphery, and periphery countries as well as those of leader and follower economies. I subsequently describe the methodology implemented to empirical classify

[16]This study does not aim at investigating the origin nor the very nature of the underlying macroeconomic dynamics behind these categories. Rather, the taxonomy is exploited as a practical tool to perform analyses on financial interdependencies.

countries in these categories. I finish the subsection by providing a concise description of the causal hypothesis that structures Chapters 2 and 3.

Influential taxonomies

This subsection provides an overview of three influential perspectives or sets of taxonomies that have been used to conceptualize economic relationships between countries.[17] Each perspective enables to structure the global economy into different layers of economic development and/or influence. It is relevant to note that, in most cases, these perspectives do not contradict each other. Rather, they are different tools designed to highlight different dynamics.

The first perspective is the Braudel–Wallerstein's *center-periphery approach*, also called *world-system approach*.[18] It is based on Braudel (1975) and Wallerstein (1974, 1976).[19] This perspective focuses on an explanation of the emergence of modern capitalism highlighting that some regions of the global economy benefit from the world economic organization of trade and finance, while others do not. The center-periphery (or core-periphery) model can be viewed as a spatial metaphor describing an occupational and functional continuum separating the advanced or metropolitan "center" and a less economically developed "periphery," either within a particular country, or (more commonly) within the global economy. It is a flexible framework where the identifications can be made at

[17]This section does not aim at providing an exhaustive list of such paradigms nor to be a formal introduction to all existing approaches but to simply highlight different ways to conceptualize the global economy in order to epistemologically situate the approach used in Chapters 2 and 3. In addition, specific taxonomies can have characteristics of more than one paradigm or do not fit perfectly the simplified descriptions developed here.

[18]In the literature based on these authors, the concepts of *world-economy* or *world-system* are commonly used. For the sake of simplicity, I consider these concepts as substitutes to the term of global economy, preferred here because it is more commonly used in the recent economic literature.

[19]Fernand Braudel and Immanuel Wallerstein did not work together and their views on the global economy are not identical. Yet Wallerstein (1974) did consider himself to be following Braudel's earlier theories on the rise of capitalism. Both authors studied the emergence of capitalist trade and the "European world-economy," and focus on the revolutionary political and economic developments. These two thought schools are also characterized by significant differences relative to their views on the geographic division of labor – between town and country, between "center" and "periphery." For instance, for Braudel, this geographic division erupted in the 12th and 13th centuries in Europe, while for Wallerstein the division emerges much later, around the 16th century. However, common important features are specific to their approaches and I overview them here as a single perspective for conciseness. Similar simplifications also apply for the other approaches.

a national level (the US or Japan are model more as centers than Bulgaria, Ethiopia or Cambodia) or be more specifically placed (nations and regions may have their own centers in particular localities). Countries (and any economic areas) can be ordered depending on their economic development stages, the nature of the trade relationship, and their capacity to generate added value. Since the seminal works of Braudel and Wallerstein, different but related perspectives have used the conception of center–periphery relationships as systemic relationships of economic inequality existing in the modern global economy (e.g., Babones and Chase-Dunn, 2012; Hannerz, 2015). A common feature is the existence of a three-layer structure of the global economy (center, semi-periphery, and periphery) which has been used several times by a variety of studies (e.g., see Arrighi and Drangel, 1986; Korzeniewicz and Martin, 1994; Babones, 2005; Babones and Chase-Dunn, 2012; Morales Ruvalcaba, 2020).[20] The main taxonomy used in Chapters 2 and 3 is derived from this paradigm.

A second set of approaches can be called the *institution-based perspective*. They are (in most cases) rankings used by international institutions used either to implement some policies (e.g., to define thresholds required to assess the eligibility of a country) or build analyses and datasets (e.g., the use of the distinction between "emerging markets" and "advanced economies"). A core feature of these approaches is that they rely on a predetermined set of measurable indicators or approximates (e.g., adult literacy rate). In that regard, most of these categories use the level of GDP per capita (or very close measures) as a key measure of economic development.[21] The origins of most of these approaches lie in the development of national accounting practices, the rise of the influence of governments in economic affairs, and the wave of decolonization after WWII. One of the first major instance to emerge is the concept of *least developed countries (LDCs)* which was created by the United Nations (UN) to classify countries that exhibit the lowest indicators of socioeconomic development. The list of LDCs originated in the late 1960s for the needs

[20] Notably, it does not exist a widely-accepted and up-to-date classification.

[21] As an illustration, the World Bank's International Debt Statistics (IDS) database distinguishes *Low- and Middle-Income Countries*, *Low-Income Countries* and *Middle-Income Countries* based on thresholds for their Gross National Income (GNI) per capita.

of the United Nations Conference on Trade and Development (UNCTAD) and was first published in November 1971 based on GDP per capita, adult literacy rate, and share of manufacturing in GDP. Another example is the concept of *emerging markets*.[22] The term was first coined by the World Bank in 1981 to describe economies that were in transition from developing to developed status and were characterized by high growth rates, a growing middle class, and increasing integration with the global economy. The concept gained widespread acceptance in the 1990s, as investors began to seek out higher returns in these fast-growing markets, and progressively replaced other terms like LDCs.[23] Many financial institutions have been providing list of emerging markets, notably the IMF. The GDP or GNI per capita in purchasing power parity (PPP) are commonly used to classify countries.[24]

The third and last perspective refers to a set of *theme-based approaches*. A core difference with the center-periphery paradigm is that these descriptions of the global economy are often more specific, less holistic, and are used to describe *shorter-term* economic or political dynamics (i.e., between 2 to 30 years). The categories include the BRICS (for Brazil, Russia, India, China, and South Africa), G20, Tiger economies, and PIGS (for Portugal, Italy, Greece, and Spain). These examples show that some of these categories aim at promoting some countries (e.g., BRICS, Tiger economies) while some are derogatory classifications (e.g., PIGS).[25] Two influential approaches are worth mentioning as they directly refer to global financial interdependencies. Firstly, in the aftermath of the 2007-2009 Global Financial Crisis (GFC), inspired by the notions of “too-big-to-fail” and systemically-important financial institutions, several studies started to apply the concept of systemically-important to refer to economies that have the potential to generate spillovers on other countries through various channels. This approach was developed by

[22]For simplicity, I don’t differentiate the concepts of emerging markets and emerging economies.

[23]The term can also be misleading as there is no guarantee that a country will move from “less developed” to “more developed” and has been used in many occasions to represent countries that were at best stagnating or suffering from a “premature desindustrialization.”

[24]For example, the main criteria used by the IMF are GNI per capita, export diversification, and a measure of financial integration (see `www.imf.org/external/pubs/ft/weo/faq.htm#q4b` for details).

[25]In some circumstances, the concept of emerging markets may be better classified in this perspective.

international institutions. Notably, in its reports on financial spillovers (IMF, 2011, 2012), the IMF developed the concept of five systemic economies, comprising China, the Euro Area, Japan, the United Kingdom, and the United States (S5). Academic publications have exploited the concept as well to describe the global economy (e.g., Bracke et al., 2010).[26] However, in most cases, the classification of countries as systemically-important relied on *ad hoc* considerations, without clear nor explicit methodologies. Secondly, another common classification consists in distinguishing countries that ran current-account surpluses from those that runs current-account deficits. Likely, some studies refer to the difference between net creditors and debitors. This categorization is even sometimes viewed as the traditional distinction between the center (i.e., those exporting capital) and the periphery (Bernanke, 2006; Bordo et al., 2007). This remark is sometimes used (mostly by financial analysts) to suggest that the center-periphery model is not as appropriate to describe the global economy after the 1970s as it was to analyze the 19th century.[27] However, it is important to note that the Braudel–Wallerstein's center-periphery approach introduced above as well as the center-periphery approach developed below do *not* fall into this context. They do not consider the direction of capital flows as the central phenomenon. Rather, they primarily define the concepts of center and periphery based on trade and occupational characteristics (which have important financial implications as suggested by the different chapters).

[26]Based on the framework developed below, all the S5 are considered as sources of financial spillovers with the exception of China. For the very reason that China has become a very influential economy in the recent decades, Chapter 4 provides a specific analysis of the influence of the country-continent on international monetary policy spillovers.

[27]For instance, Bernanke (2006) claims that "*the traditional distinction between the core and the periphery is becoming increasingly less relevant, as the mature industrial economies and the emerging-market economies become more integrated and interdependent. Notably, the nineteenth-century pattern, in which the core exported manufactures to the periphery in exchange for commodities, no longer holds, as an increasing share of world manufacturing capacity is now found in emerging markets. An even more striking aspect of the breakdown of the core-periphery paradigm is the direction of capital flows: In the nineteenth century, the country at the center of the world's economy, Great Britain, ran current account surpluses and exported financial capital to the periphery. Today, the world's largest economy, that of the United States, runs a current-account deficit, financed to a substantial extent by capital exports from emerging-market nations.*"

Center and periphery countries

The distinction between center, semi-periphery and periphery countries is derived from the center-periphery approach developed by Braudel (1975) and Wallerstein (1974, 1976). It is a taxonomy based on the role of economies in the international division of labor and global value chains. The central notion is that countries (and economic areas) can be ordered depending on their economic development stage and capacity to generate added value. In other words, the difference between the categories lies in an occupational and functional continuum characterizing the global economy. Center countries, also called core countries, specialize in activities generating high levels of added value in the international division of labor and in global value chains. Their largest firms have become Multinational Enterprises (MNEs) owning and controlling important *intangible assets*, notably in international management know-how, innovation capacities, and marketing/branding know-how.[28] These intangible assets enable firms from the center to control major IPNs for goods and services. Countries of the center are characterized by a high degree of diversification and differentiation in terms of production and exports, a high degree of technological innovation, and deep and diversified financial markets.[29] Acting as a guarantee of international solvency, the control of center economies on international intangible assets and IPNs enables them to borrow abroad long-term in their own currencies. They tend to produce and export high-quality goods and services requiring capital-intensive technologies and employing highly skilled and highly paid workers. Germany, Japan, Switzerland, Luxembourg, and the US are examples of center economies.

Periphery countries, also referred to as peripheral countries, remain without recourse in low-added-value activities in international trade. They specialize in agricultural pro-

[28]An intangible asset is an asset that is not physical in nature; examples include goodwill, brand recognition, trademarks, and copyrights but also intellectual property, patents and management expertise. Intangible assets exist in opposition to tangible assets, which include land, vehicles, equipment, and inventory. Financial assets such as stocks and bonds, which derive their value from contractual claims, are considered tangible assets.

[29]By deep financial markets, we mean here that the main financial markets in these economies (bond markets, stock exchange, etc.) are characterized by high trading volumes and small spread between the bid price and the ask price (in comparison with the financial markets of other countries), relative to the size of the considered economy.

duction, raw materials, and basic tourist services. Their exports are usually characterized by a (very) low degree of diversification. Their firms do not possess any of the necessary intangible assets to build or control IPNs. Their remote geographical location with respect to center economies, their limited pool of skilled labor, and their insufficient development of transport and energy infrastructure preclude insertion of their domestic firms in IPNs. Most of their exports and distribution infrastructures are controlled by foreign-based MNEs, and they are technologically or financially dependent on the center – and/or the semi-periphery. Workers of the periphery are paid low wages and are usually much more politically and economically coerced than workers in the center. The periphery includes Ethiopia, Niger, Yemen, Laos, and Nepal. In between these groups lie semi-periphery countries. These economies have sufficient skilled labor and developed infrastructures to enable them to penetrate IPNs through inward FDI and outsourcing. Their export structures are more diversified than that of periphery countries as they export manufactured products and services (some with large high-tech contents). Their development prospects depend on their capacity to move up the value chain and obtain the intangible assets enjoyed by the MNEs of the center. Some of the most advanced national firms of semi-periphery economies might evolve into MNEs, but they seldom control the IPNs. Their position in the international division of labor is intermediate in terms of capture of global added value. South Africa, Mexico, Brazil, Malaysia, Greece, and Baltic countries are part of the semi-periphery. The following concise definition summarizes the core concepts:

Definition 1.2. *Center countries are those which own and control large intangible assets relative to their population. Periphery countries are those which do not possess any significant intangible assets. Semi-periphery countries are intermediate economies.*

Various regional economic integration policies have been implemented over the past decades: the single market of the European Union (EU), the European System of Central Banks (ESCB), the North American Free Trade Agreement (NAFTA), the Association of Southeast Asian Nations (ASEAN) as well as many other Economic Partnership Agreements (EPAs) and Free Trade Agreements (FTAs). These integration processes highlight a key characteristic of the global economy: Economic activity is not structured within national borders.[30] Global value chains cut across national borders, tying the entire interstate system into a single world-system. In this context, countries are used in this study as main entities and classified accordingly primarily because the political arena and a large part of the available data are based on national divisions. This is important for at least two reasons. First, it is not because a country takes part in a regional integration agreement that its economic development or position on the center-periphery axis changes.[31] Mexico did not become a center economy after join Canada and the US through NAFTA. Similarly, Portugal and Greece did not emerge as new center countries by joining the ESCB or the EU. The very reason is that the position of a country on the center-periphery axis is first and foremost determined by their ability to control intangible assets and IPNs, which are characteristics that are not directly affected by these regional integration processes.[32] Second, large economies are characterized by considerable economic heterogeneities; even more than their smaller counterparts. Although the gaps in terms of economic wealth, disposable income per capita, and productivity (e.g., in gross value added per hour worked) are considerable between London and Wales in the United Kingdom (UK), these differences are much larger within country-continents like China and India. In China, Shanghai and the Pearl River Delta Metropolitan Region are highly advanced economic zones and can easily be classified as part of the center. In

[30] Historically, this aspect emerged much before these recent regional economic integrations.

[31] Yet it can be argued that economic integration agreement can potentially be helpful in the medium- or long-term to promote industrialization and reinforce economic integration with center economies through IPNs which can eventually alter the position of the country on the center-periphery axis.

[32] As an illustration, we can consider a few data relative to Greece. The indicators of economic complexity for Greece are lower than for Bosnia-Herzegovina and Serbia (for a quick overview, see `https://oec.world`). Around 80 % of its service trade (in value) is made of sea transport and personal travel, with almost no exports in financial services or royalties and license fees. This can be contrasted with the case of Belgium (a country close in terms of population size, with an important logistic location, and classified as a center economy): with around 6 % of service exports in financial services and a bit less than 50% in business, professional, and technical services, with much higher values in terms of economic complexity and export diversification and a GDP-per-capita around 2.5 times higher than Greece. These few elements clearly confirm that Greece is not a center economy despite being in the EU and in the Eurozone – which contradicts one of the core principle of the monetary union that the member states are "similar" and can/should therefore withstand the same level of interest rates.

the meantime, some regions remain very poor (despite the fast reduction in poverty these last decades), notably in Xinjiang, Qinghai, Tibet, Gansu, Heilongjiang, and Guangxi. If isolated, these regions would likely be classified as part of the periphery. This aspect challenges the classification of countries in different categories. Fortunately, the core of the analyses in Chapters 2 and 3 does not rely heavily upon these large economies - in particular because of the restrictive capital control policies implemented by China, the large sample of countries used and the temporal horizon (between 1970s to now). In addition, the leader-follower axis complements the taxonomy to partially account for this dimension.

Leader and follower countries

The concepts of *leader* and *follower* are used to model the world-system structure as multi-dimensional hierarchies of political and economic powers and interdependencies. The distinction indicates the ability of a country's government to influence global economic governance. This second axis can also be viewed as a response to some of the critics on the center-periphery and GDP-per-capita-based approaches. In particular, the economic rise of China has triggered numerous debates on the appropriate way to concisely model the global economy. Classify China as a "semi-periphery country" could be viewed as in contradiction with its massive macroeconomic influence, its enormous reserve accumulation and trade surplus, and its position of major creditor in the global economy. The leader-follower axis enables to combine the best of both worlds: keeping the richness of the center-periphery approach while allowing to acknowledge the existence of another key dimension that structure the global economy.

In its simplest formulation, this dimension can be understood as a classification between three categories: world-leader, regional-leader, and follower countries. World-leader countries enjoy very large domestic markets, important financial resources, and major technological and military capacities. They can act as a global power exerting a leadership on the countries that do not possess the same advantages, influencing the followers among all regions of the world. They can generate deadlocks in global governance and can sometimes propose technological standards and constraining trade restrictions. Their markets are the largest in the world and their population can constitute a significant part of the world's urban population. World-leader countries have enormous military capacity. The US since Word War II typifies the category. Since the 2007-09 GFC, China is another crucial example. A second group is composed of regional leaders with a more limited sphere of influence. They can have macroeconomic impacts on the world economy, but usually only on specific sectors and/or less major impacts than those of world-leaders. Their influence is regional (a local influence on smaller countries) and specialized in some areas. They are significant players in global governance but cannot block processes on their own.[33] Follower countries are economies (from the center, semi-periphery or periphery) that are too small to have any major, diversified macroeconomic influence. Their market sizes and their populations may be much smaller than those of leader countries (e.g., Iceland, Luxembourg, Malta, and Lesotho). In addition, followers have no real substantial sphere of influence and only a marginal influence on global governance processes. Follower countries have limited military capacity and their diplomatic influence is often marginal. As for the center-periphery axis, the notions of leader and follower can be summarized as follows:

Definition 1.3. *The leader countries are those which have a great macroeconomic influence on other countries. The follower countries are those which are most affected by the macroeconomic influence of, without themselves largely affecting, the leader countries*

These distinctions may required a few illustrative examples. China, Russia or India are clearly not center countries on the basis of their roles in the global division of labor. However, they are (world or regional) leaders because they can influence global or/and regional governance and exert a leadership on some followers (due to their large populations, their activist international policies, their economic powers, their military capacities. etc.).

[33]In this sense, Mexico and India can be seen as regional leaders because they can influence small close economies – examples include Belize and Guatemala in the case of Mexico, and Bangladesh and Sri Lanka for India.

The United States is a world-leader and center economy. On the other hand, Luxembourg, Switzerland and Belgium are unambiguously part of the center (all being wealthy centers of trade, finance and/or administration), but they carry much less weight in the political and economic international arena than China, Russia or India.

Classification of countries

To classify countries according to the above categories, I rely on a data-driven clustering procedure. The dataset contains 138 countries over the period 1975-2016. Due to the very large size of the sample in terms of numbers of countries and time span, the methodology had to adjust to the constraint of available data. Therefore, the data are viewed as *proxies* used to provide an empirical approximation for the theoretical categories. The algorithm exploits 10 quantitative indicators, including GDP, demographic data, an education index, and the number of firms in the Global Fortune 500. Specifically, the separation between center, semi-periphery, and periphery countries is based on five measures: current GDP per capita, urbanization (as percentage of total population), percentage of population under 14, an education index, and a natural resource rent index.[34] The estimate of the leader-follower axis is based on five other macroeconomic and demographic indicators: current and real GDP, number of firms in the Global Fortune 500, total urban population, and total population.

The classification hinges on a statistically selected set of clustering algorithms which are used to propose groups of countries, called clusters, matching the theoretical categories. More specifically, seven clustering algorithms with six different numbers of clusters (from 8 to 13) – a metaparameter – for each algorithm have been used. The obtained clusters are subsequently classified as one of seven categories based on the theoretical

[34]The natural resource rent index is calculated by the World Bank "*as the difference between the price of a commodity and the average cost of producing it. This is done by estimating the price of units of specific commodities and subtracting estimates of average unit costs of extraction or harvesting costs. These unit rents are then multiplied by the physical quantities countries extract or harvest to determine the rents for each commodity as a share of gross domestic product*" (data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS).

framework.[35] Every country in our sample is classified within 42 (7×6) different clusters, which are themselves associated with a category. A country is associated with the specific category to which it has been ranked the most times.[36]

Because the global economy is dynamic, I classified countries in three subperiods: 1970–90, 1990–2002, and 2002–16. The baseline classification of semi-periphery countries includes countries that have been in the same category for at least two periods.[37] Figures and tables of this study exhibit results based on this baseline sample. The group of center leader countries is made up of only five countries: the US, the UK, Japan, France, and Germany. These five countries are viewed as being at the root of the economic interdependencies (see below). Brazil, India, Mexico, and Russia are included in the regional-leader semi-periphery countries for all three periods. Twelve and 56 countries are classified as follower center and semi-periphery countries for the three subperiods, respectively.[38]

Fundamental causal hypothesis

Chapters 2 and 3 both model the financial influences of center (world and regional) leader countries on semi-periphery nondominant – meaning both regional-leader and follower – countries. Figure 1-1 schematizes the hypothesis that macroeconomic phenomena in center leader countries are the main factors influencing the international financial conditions that affect semi-periphery nondominant countries. International financial conditions refer here to international liquidity, key interest rates, global average rate of returns, na-

[35]These categories are world-leader center, regional-leader center, follower center, world-leader semi-periphery, regional-leader semi-periphery, and periphery countries.

[36]In other words, a country is associated with a theoretical category based on the average of 42 different clustering sub-procedures. Details on the classification algorithm and the results obtained are developed in Section B.1.

[37]A more conservative alternative including only countries that have stayed in the same category and excluded those that have moved from one category to another was tested. For example, in such scenario, South Korea is excluded because it is classified as a semi-periphery country for the first period and a center country for the third period.

[38]China is the only world-leader semi-periphery country for the last period, but it is only a regional-leader semi-periphery country in the two preceding periods. Because of its strong capital control policies and its recent vast economic rise, China is not included in semi-periphery countries in the baseline scenarios (see below).

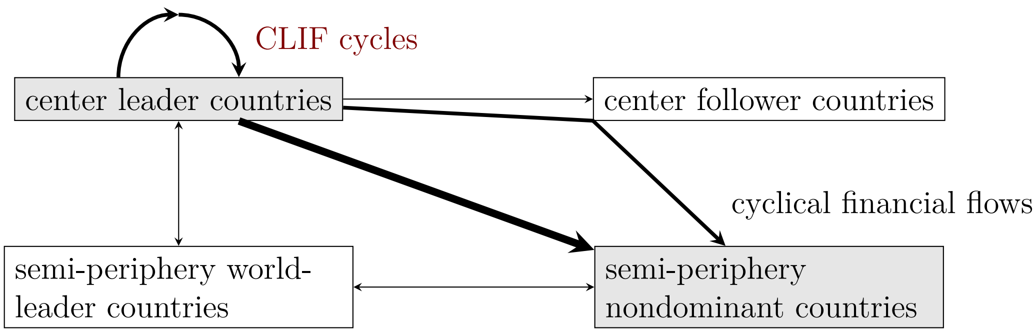

Figure 1-1: Fundamental theoretical framework

The figure schematizes the hypothesis that center leader countries modeled as at the origin of the financial interdependencies. Industrial-financial cycles are macroeconomic medium-term phenomena in center countries and are explained in Subsection 1.2.4. Cyclical financial flows are financial flows triggered by industrial-financial cycles in center economies and are considered as the fundamental source of financial influence on semi-periphery nondominant countries. Subsections 3.2.1-3.2.2 develop the nature of these cyclical international financial flows. Arrows indicate the magnitudes of hypothesized influences and their directions.

ture of major financial instruments, etc. The overall influence of center follower countries is assumed to be due to their systemic role as conduits, vectors or buffers of the macroeconomic influence of center leader countries. Semi-periphery world-leader countries have a singular position. They can be largely integrated – China after the GFC – or relatively isolated – the Union of Soviet Socialist Republics (USSR) after WWII. In both cases, they reciprocally influence semi-periphery nondominant economies. Indeed, this latter set of countries has been massively impacted by their integration to semi-periphery world-leader countries (notably, Eastern European countries to the USSR before 1991 and South-East Asian and some Latin American countries to China since the 2000s). Conversely, semi-periphery world-leader countries are dependent on their integration with semi-periphery nondominant countries. Center economies are also co-influenced by semi-periphery world-leader economies. A clear example is the current massive economic integration between China and the US. The overall impact of center economies of the capitalist system on semi-periphery nondominant countries is therefore conditional on the internal and external macroeconomic changes in semi-periphery world-leader economies. Yet, for the sake of conciseness and simplicity, except when these economic mechanisms have massively impacted the financial interdependencies between center leader countries and semi-periphery nondominant countries, this analysis focuses mainly on semi-periphery nondominant countries. For easy readability, the term “semi-periphery countries” is therefore used hereafter as substitute for semi-periphery nondominant countries.

1.2.4 Medium-term cycles in center countries

The notions of medium-term industrial and financial cycles characterizing the center leader economies are explained in this subsection. In addition to major pull factors (see Subsection 3.2.1), these cycles are regarded as being at the origin of large financial flows from the center to the semi-periphery. The section starts by introducing the concepts of financial and industrial cycles. Then, the notion of CLIF cycles are described.[39]

Financial cycles

Financial cycles emerged as a macroeconomic concept required by economists who found that interest rates could not capture all the interactions between the financial and industrial sectors. Researchers have documented some relationships between credit, asset prices and real economic activity and leading indicators of financial distress have been developed using various data beyond interest rates (e.g., Goodhart and Hofmann, 2008; Gerdesmeier et al., 2010; Schularick and Taylor, 2012). The 2007-09 GFC spurred the growth of this literature and several contributions developed the concept of financial cycle (see Claessens et al., 2011; Borio, 2014; Aikman et al., 2014). Importantly, financial cycle peaks are markedly and closely associated with financial crises.[40] A major historical fact is that the length and amplitude of the financial cycles have significantly increased since the mid-1980s. Drehmann et al. (2012) and Borio (2014) hypothesize that this fact reflects financial liberalization processes and changes in monetary policies.[41]

[39]Details about how to build indicators of these industrial and financial cycles are provided in Section 2.2.3 and Appendix A.2.

[40]In Drehmann et al. (2012), all the financial crises with domestic origin occur at, or very close to, the peak of a financial cycle. Conversely, almost all peaks coincide with financial crises. For only three examples the peak is not close to a crisis: Germany in early 2000s, and Australia and Norway in 2008/2009. But all three correspond to periods of large financial distress.

[41]Financial cycles are longer than the traditional business cycles and have significant macroeconomic impacts. In that sense, Borio (2014) states that “it is not possible to understand business fluctuations

Two main approaches are used to determine financial cycles: analysis of turning points and frequency-based filters. Here, medium-term cycles are estimated by means of a frequency-based filter approach. Mainly due to data limitations, evidence of financial cycles has almost exclusively been made for only a few center countries. For this reason, medium-term cycles are used to characterize center economies. Based on Drehmann et al. (2012) and Borio (2014), the following definition is proposed:

Definition 1.4. *Financial cycles are the medium-term component in the joint fluctuations of private credit, the credit-to-GDP ratio, and real-estate prices.*

Industrial cycles

Center economies repeatedly experience periods of overcapacity in their productive sectors.[42] These overcapacities cause declines in productive investments in industrial capacities.[43] The importance of these industrial cycles has been expressed by major economists (e.g., Marx, Keynes, Schumpeter) and recent research (Xu and Liu, 2018). Industrial cycles differ from the conventional business cycles although the two concepts are highly intertwined. The latter are relatively shorter-term fluctuations of real GDP around a longer-term growth trend. As traditionally measured, business cycles extend from one to eight years (e.g., Artis et al., 2011; Jordà et al., 2017).[44] Industrial cycles are slightly longer-term variations (between eight and 15 years for a period in our estimates).

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and the corresponding analytical and policy challenges without understanding the financial cycle."

[42]By an overcapacity situation we mean that the productive sector has excessive capacity to produce relative to the aggregate demand. This leads to overproduction and a decrease firms' profitability. Often these overcapacities are specific to certain industries (automobile, electronic, etc.). Here some illustrative examples: (i) the US economy faced serious overcapacities in several industries and notably in steel and automotive after the dot-com crisis (Aglietta and Berrebi, 2007); (ii) plunges in international oil prices are the counterpart of an overproduction relative to the effective demand; (iii) recent situations of overcapacity in China (Xu and Liu, 2018). The aggregation of overcapacities in several industries can lead to an overall state of overcapacity in the economy if these enterprises are sufficiently influential at the macroeconomic level. Alternatively, the terms overproduction, oversupply, excess of supply, and over-accumulation are also used in the literature to describe overcapacity situations (or close and related macroeconomic dynamics). In addition, in Keynesian terms, a situation of overcapacity is intertwined with a macroeconomic stage of low effective demand.

[43]Productive investments refer here to the sum of gross fixed capital formation and changes in inventories in agriculture, industry (manufacturing, construction, mining, etc.), transport, storage and communication.

[44]This is the range that statistical filters target when seeking to distinguish the cyclical from the trend components in GDPs.

They are also more relevant for highlighting major changes in gross fixed capital formation and in the utilization of existing production factors in center economies.

Situations of overcapacity are characterized by low levels of utilization capacity and productive investment. Lower profitability in productive investments are partially caused by overcapacity which accentuates competition between firms and decrease their mark-ups. Based on the formulation of financial cycles and on the idea that labor and industrial capital are the main production factors, industrial cycles are defined as follows:[45]

Definition 1.5. *Industrial cycles are the medium-term component in the joint fluctuations of capacity utilization, unemployment rate, and GCF (in percentage of GDP) in center countries.*

An overcapacity crisis, meaning the downward phase of an industrial cycle, refers to a situation in which production factors are largely underused. In such periods, workers are increasingly unable to find jobs. Growth in productive capacity (for example, triggered by technological progress) far beyond an expansion that consumer markets can bear results in unused plants and equipment and large gluts of unsold commodities (as well as a larger number of unemployed workers). The profitability of firms and productive investments in industrial capacities contract. In trying to maintain their profitability rates, firms have fewer incentives to invest in new production capacities and a still greater need to cut costs. As investors seek high yields, this means a diversion of a share of investment towards the semi-periphery (e.g., from Japan to the Philippines) and the financial sectors of the center (larger allocations of funds into the residential prices and financial products).

Center leaders' economies industrial-financial cycles

Periods of industrial and financial contractions are interconnected (e.g., some evidence can be found in Jordà et al., 2017). During downward phases of financial cycles, information flows in financial markets experience particularly large disruption. Financial markets

[45] Although the employment rate is more in line with the other two indicators and the development of productive capacity in the industrial sector than the unemployment rate, I use the latter because of its greater availability of data.

are unable to allow an efficient allocation of capital, and financial asset and house prices plunge. Balance sheets of many financial and non-financial companies holding these assets come under pressure (Koo, 2011). In this environment, the effective demand falls (particularly without government interventions). The national production cannot longer be absorbed. The degradation of balance sheets and of effective demand provokes an overcapacity situation. Likewise, a massive upward phase in the financial cycle leads to higher effective demand, which increase the output, and hence creates a more favorable economic conditions for larger productive investments. A rise in financial assets can compensate for a situation of overcapacity (by rising effective demand and providing credit to the economy) but can also accentuate the forthcoming overcapacity crisis (for example, firms' overoptimistic anticipation on effective demand leading to inappropriate productive investment in new production capacity).[46]

The emergence of overcapacities also contributes to financial disruptions. The decreased profitability experienced by firms during the downward phases of industrial cycles deteriorates many financial assets. First and foremost, it concerns the stock values that rely on firms' profits. In addition, the decrease in productive investments leads to a decrease in demand for financial products and a general decline in the profitability of financial institutions. Indeed, the macroeconomic "solutions" to overcapacity take forms as diverse as plant shutdowns, the "destruction" of physical and human capital, depressions, banking crashes, inflation, etc. In this sense, the downward phase of industrial cycles contributes to the downward phase of financial cycles. On the opposite side, new technological developments, increased productivity, cuts in human costs, and other factors that resolve an overcapacity crisis have favorable impacts on financial markets and hence support the upward phase of financial cycles.

In addition, a situation of overcapacity implies the inordinate lagged rise of financial markets, as investments in the financial innovations, production of new credits, in lands

[46]This is particularly noticeable in Japan before the crisis the 1990s or in the US subsequently to the burst of the dot-com bubble and before the GFC.

and properties are substitute for productive investments.[47] The contraction in productive investments in industrial capacities depreciate financial assets relative to what their values could have been otherwise but might subsequently increases their values relative to other goods.[48] In other words, as profit rates fall in the productive sectors of an economy, investors, and firms progressively shift their investable funds out of reinvestment in plant, equipment, and labor power, and instead seek refuge and higher returns in financial assets. The downward phase of industrial cycles creates favorable conditions for the subsequent rise in financial cycles. These interconnections between financial and industrial cycles are highlighted by their empirical synchronization.[49] The definition of industrial-financial cycles directly results from this hypothesis and Definitions 1.4 and 1.5. They are the joint fluctuations of industrial and financial cycles.

Over the last 50 years, center economies have widely and continuously integrated their goods, services and financial markets. The most prevalent example is European integration through the EU and the ESCB. Center leader countries, major international institutions, such as the World Trade Organization (WTO) and the IMF, private enterprises (banks, car companies, software companies, etc.), and central banks created favorable political and economic conditions for the unification of economic policies between different national markets, chiefly through the partial or full abolition of restrictions on international trade and capital movements. Importantly, beyond the organized *de jure* integration, MNEs *de facto* constructed large IPNs. Most of these networks interconnect center economies through large intra-firm transactions. These interconnections between markets of center economies contribute to a rising uniformization and synchronization of domestic economic conditions. This has been studied for business cycles from both long-term and shorter-term perspectives (e.g., Aguiar-Conraria and Joana Soares, 2011;

[47]This is particularly important for long-term analysis but less essential for understanding of medium-term cycles.

[48]This argument is quite similar to the one explained more in detail in Subsection 3.2.2 about the volume and substitution effect. The global decrease in productive investment due to the overcapacity crisis led to a negative volume effect on financial assets. However, there is also a substitution effect that increases the demand and price of financial assets relative to goods in the economy.

[49]The hypothesis is confirmed empirically (see Appendix A.2 for details).

Bordo and Helbling, 2011; Artis et al., 2011; Belke et al., 2017). Based on the large synchronization between the medium-term cycles, we assume that the main results of this literature hold for industrial and financial cycles. This indicates that such cycles are substantially affected by economic conditions in foreign markets. Because economic conditions abroad greatly influence domestic conditions, it seems reasonable to deduct that business, financial, and industrial cycles between center economies have a significant commonality. Due to their high degree of economic integration during the period 1970-2020, center economies experience synchronized industrial-financial cycles.[50] Therefore, as we intend to determine the nature of the relationships between the center and the semi-periphery, rooted in productive and financial interconnections, this hypothesis leads us to concentrate the analysis on CLIF cycles:

Definition 1.6. *Center Leader economies' Industrial-Financial cycles (CLIF cycles) are the common component resulting from the synchronized industrial-financial cycles of center leader countries.*

This joint component between the two medium-term cycles among center leader countries is viewed as the fundamental root that triggers massive changes in international financial flow allocations between the center and the semi-periphery.

This influence from the center on the semi-periphery is first and foremost modeled in this study as resulting from medium-term macroeconomic cycles characterizing center economies. Two types of medium-term cycles can be distinguished: financial and industrial cycles. Based on Drehmann et al. (2012); Borio (2014), as described in Chapter 3, Definitions 1.4 and 1.5, the former represents the medium-term component in the joint fluctuations of private credit, the credit-to-GDP ratio, and real-estate prices in center countries and the latter indicates the equivalent for fluctuations of capacity utilization, unemployment rate, and GCF (in percentage of GDP).[51] These financial and industrial cycles are interconnected and synchronized. Moreover, center economies' cycles have

[50]This hypothesis is confirmed by high correlations between our estimates. See Chapter 2 and Appendix A.2 for more details regarding statistical evidence.
[51]See Section 2.2.3 and Appendix A.2.1 for details on data and estimates of these cycles.

become more and more synchronized as well.[52] Therefore, to summarize the macroeconomic conditions of center leader countries, this study exploits the concept of CLIF cycles. They represent the joint fluctuations of industrial and financial cycles, that is the average macroeconomic situation of the different sectors of these economies.

1.3 Globalization and monetary policy

Globalization may have profound implications for the transmission of monetary policy and monetary autonomy in general. Globalization has affected monetary transmission channels in diverse ways and has added more complexity to the way monetary policy is transmitted to the real economy. As an illustration of the importance of financial interdependencies on policy implementation, this section reviews notable elements of the empirical literature on the impacts of economic globalization on monetary autonomy.[53] Table 1.1 provides an overview of the main impacts of economic globalization on monetary policy effectiveness and autonomy that have been identified. This literature review is composed of three parts. Section 1.3.1 summarizes empirical academic literature on the evolution of monetary policy effectiveness and spillovers over these last decades. These analyzes provide insights on the general influence over time of economic globalization on monetary policy interdependence and effectiveness. Then, Section 1.3.2 compiles the main results of academic literature on the impacts of globalization on specific monetary policy transmission channels. Lastly, the impacts of globalization on some other dimensions of monetary policy autonomy are briefly introduced in Section 1.3.3.

[52] For further discussions on synchronization of the different cycles, interested readers can refer to Bordo and Helbling (2011); Artis et al. (2011); Belke et al. (2017); Zelazowski et al. (2016); Jordà et al. (2017).

[53] This section does not aim at being a comprehensive review of the literature related to this topic. Rather, it exemplifies how the different chapters contribute to the debate on the impact of economic globalization on monetary autonomy. Alternatively, the methodological and empirical highlights in the following chapters can be used to discuss the influence of economic globalization on fiscal autonomy. For example, the findings of Chapters 2 and 3 support the view that medium-term cycles in large center economies impact the conduct of fiscal policies in semi-periphery countries. Likewise, while Chapter 4 discusses an econometric methodology to assess international monetary policy interest rate spillovers, these methodological findings can be applied to estimate the impacts of various integration mechanisms on fiscal policies.

Channel/Policy	Mechanism or observed effect	Sign	References
Overall impact on monetary policy effectiveness and spillovers (Section 1.3.1)			
	Decrease in monetary policy effectiveness in the US	−	Barth and Ramey (2000); Boivin and Giannoni (2006); Boivin et al. (2010)
	Large and rising international monetary spillovers	−	Antonakakis et al. (2019); Crespo Cuaresma et al. (2019); Chapter 4
Effectiveness of monetary policy transmission channels (Section 1.3.2)			
Interest rate channel	Downward trend in natural and real interest rates reducing policy space	−	Holston et al. (2017); Del Negro et al. (2017); Neri and Gerali (2019); Wang (2019)
	Greater influence of global financial cycles on long-term interest rates and asset prices	−	Miranda-Agrippino and Rey (2015); Passari and Rey (2015); Rey (2015, 2016)
	Greater inequality led to more credit-constrained households (−) yet increases MPC out of current income (+)	+/−	Ampudia et al. (2018)
Credit and interest rate channels	Increase in non-bank funding sources which might insulate from changes in bank funding conditions (−) and/or react even more than banks (+)	+/−	Carlino and DeFina (2000); Fuentes (2006); IMF (2016)
	Increase in the manufacturing sector in semi-periphery economies (+) and decrease in center economies (−)	+/−	Georgopoulos (2009); Georgiadis (2015); Vespignani (2015); van Neuss (2018)
	Greater risk of recessions with debt-constrained firms	−	Koo (2011)
Credit and wealth effect channels	Global cycles cause large fluctuations in asset prices	−	Miranda-Agrippino and Rey (2015, 2020)
	Greater impact of housing price cycles	−	Fratantoni and Schuh (2003)
	Greater share of stock-market wealth while MPC out of non-stock-market wealth is larger	−	Carroll (2004); Carroll et al. (2011); Ciarlone (2011); Peltonen et al. (2012)
	Greater share of domestic wealth is accounted for by foreign assets which are less monetary-policy sensitive	−	
Wealth effect	Inequality lowers MPC out of wealth	−	
Credit channel	Global banks diversify their funding and so can insulate interest rates charged and/or compensate for a lending reduction by domestic banks	−	Schnabl (2012); Cao and Dinger (2018); Buch et al. (2019)
	Global banks transmit more external financing conditions to the domestic economy	−	Cetorelli and Goldberg (2012)
	Global banks' lending were found more closely related to local conditions than their domestic counterparts	+	Temesvary et al. (2018); Avdjiev et al. (2018)
	Banks can rebalance more easily their portfolios away from domestic borrowers	+	Correa et al. (2022)
Exchange rate channel	Greater sensitivity of exchange rate to monetary policy	+	Ferrari et al. (2021); Jarociński (2022)
	Greater share of consumption sensitive to exchange rate	+	
	Services trade more sensitive to exchange rate	+	Eichengreen and Gupta (2013); Cheung and Sengupta (2013); Cole et al. (2016)
	Greater exchange rate valuation effects as economies become more net long in foreign currency	+	Georgiadis and Mehl (2016)
	Greater competition leads domestic producers to lower their prices in reaction to decrease in import prices	+	Cwik et al. (2011)
	IPNs and invoicing patterns decrease the sensitivity of trade flows to exchange rate	−	Georgiadis et al. (2020); Bonadio et al. (2019); Amiti et al. (2022)
	Global banks more sensitive to the US exchange rate	−	Shin (2012); Bruno and Shin (2015)
Some additional impacts on monetary policy and autonomy (Section 1.3.3)			
Central bank cooperation	Abandonment of a fixed monetary system in the 1970s	+/−	Yago et al. (2015)
	Creation of a monetary union by European countries	+/−	James (2012)
	Common interventions by central banks during crises	+/−	
	Currency swap lines between central banks	+	Bahaj and Reis (2018, 2020)
Information and regulation	Complex regulatory environment and large opacity due to global banking and offshore networks	−	Nanto (1998); Nesvetailova (2007); Chavagneux et al. (2013)
Capital control	IPNs ease transfer pricing that overcomes regulation	−	
	Offshore networks impair capital control policies	−	Chavagneux et al. (2013)
Floating exchange rate	Reduction in the effectiveness of floating exchange rate regimes in isolating the domestic economy	−	Han and Wei (2018); Ligonniere (2018); Cheng and Rajan (2020)
	Fear of floating in semi-periphery economies	−	Calvo and Reinhart (2002)

Table 1.1: Summary of the impacts of globalization on monetary policy

The first column indicates the monetary policy transmission channels and types of monetary policy that have been affected by the impact of globalization. The second column briefly explains the mechanism. The third column ("sign") indicates whether the effect or evidence suggest a decrease (noted "−") or increase (noted "+") in monetary policy effectiveness and/or autonomy. The last column provides a few references were additional details can be found. MPC stands for marginal propensity to consume.

1.3.1 Evolution of monetary policy effectiveness and spillovers

Although the empirical analysis of monetary policy effectiveness is likely to be one of the most studied empirical questions in macroeconomics, only a few studies provide robust evidence regarding the evolution of monetary policy effectiveness over the last decades and most studies focused on the US.[54] Notably, using vector autoregression (VAR) approaches, several studies document that the responses of real GDP and inflation to changes in monetary policy rate in the US (federal funds rate) were greater in the pre-1980 period (the "pre-Volcker era") than in the post-1984 period (Barth and Ramey, 2000; Boivin and Giannoni, 2006; Boivin et al., 2010).[55] Although these results indicate a negative correlation between the process of financial liberalization in the US and the effectiveness of monetary policy, further studies are needed to detail the long-term evolution of monetary policy effectiveness; in particular to understand the channels of the interaction between globalization and changes in effectiveness, provide additional evidence for the post-GFC period, and assess the relation for a large set of countries.[56]

While the literature on the evolution over time of monetary policy effectiveness (mostly centered on the US) remains relatively inconclusive, the recent literature on monetary spillovers suggests that these effects are sizable and therefore that many economies have little monetary autonomy as they import their monetary policy from abroad due to their tight economic ties (Breitenlechner et al., 2021; Montecino, 2018). Additionally, the Fed

[54] For a recent US-centered survey of the (mostly VAR-based) empirical analyses of monetary policy effectiveness, see Ramey (2016).

[55] Boivin et al. (2010) attribute various reasons why the monetary transmission mechanism might have changed, such as changes in the regulatory environment affecting credit and the anchoring of expectations. Interestingly, the authors note "*One potentially important factor affecting monetary transmission arises from the increased pace of globalization and consequent increased openness of the United States and other economies. With traded goods becoming a more important sector of the economy, exchange rate movements have the potential to have a larger effect on aggregate spending. Hence the exchange rate channel of monetary transmission may have become more important over time. Such changes are likely even more important for small economies. However, these are likely less important for the United States, despite the increased importance of trade, because the net effect on aggregate demand from international trade following a monetary policy innovation tends to be close to zero, as the exchange-rate induced movements in exports tend to be offset, on net, by shifts in imports related to the accompanying changes in domestic demand.* "

[56] In contrast with the findings for the US, using data for India from 1997 to 2017, Kumar and Dash (2020) find that the effectiveness of contractionary monetary policy to reduce aggregate and sectoral inflation has increased over time. The effectiveness deteriorated a little from 2010 to 2014.

seems to play a dominant role as a key source of these spillovers (Ca' Zorzi et al., 2021, 2020), although impacted by the European Central Bank (ECB), and subject to major spillbacks from its own policies (Breitenlechner et al., 2021; Antonakakis et al., 2019). Most of these studies directly link these rising interdependencies with financial and trade globalization. Yet there is still a poor understanding of the evolution of these international monetary spillovers across time and direct evidence of the influence of globalization. Moreover, debates persist about the evolution of these spillovers after the 2007-2009 GFC (see Antonakakis et al., 2019; Crespo Cuaresma et al., 2019). Notably, the results discussed in Chapter 4 indicate that international monetary policy spillovers are sizeable and considerably increased during the 1980s and the aftermath of the GFC. The estimation results also show that economic integration has played a growing role as a determinant of monetary policy spillovers over the last four decades. In addition, this study documents the major influence of the Fed on other central banks (especially during the 2000s). However, since the GFC, the influence of the Fed has declined, and central bank monetary policy decisions tend to be even more multipolar than unipolar (or US-centered).

1.3.2 Impacts on monetary policy transmission

Globalization has considerably affected the transmission of monetary policy through greater trade and financial openness, the development of IPNs, wider dependence on international funding sources, the rise of financial and industrial cycles, the accumulation of foreign assets and liabilities, etc. Numerous studies recorded key empirical findings helping us to better understand the influence of globalization on monetary policy. This mostly refers to research documenting (i) heterogeneous levels of monetary policy effectiveness between regions, (ii) the relative importance of diverse transmission channels, and (iii) the influence of capital flows and global factor on monetary policy effectiveness. These studies provide crucial findings on the links between economic globalization and monetary policy.[57]

[57] For a recent survey of the empirical literature on the regional effects of monetary policy, see Dominguez-Torres and Hierro (2019). In addition, Ridhwan et al. (2010) provide a meta-analysis on

The main transmission channels of monetary policy are the interest rate, credit, wealth effect and exchange rate channels. These channels are not mutually exclusive and the aggregate response to monetary policy incorporates the impact of all these channels. Yet it is useful to distinguish them to provide a board view of the influence of economic globalization on monetary policy.[58]

Interest rate channel and decline in real interest rates

The *interest rate channel* is the change in real interest rates due to monetary policy that affects the intertemporal consumption and investment decisions of households and business through the transmission of monetary policy interest rates to lending (and deposit) rates. This transmission is also called the interest rate pass-through. Empirical evidence suggests that globalization has weaken the interest rate channel by (i) reducing the policy space, (ii) accentuating the effects of global cycles and shocks, and (iii) permitting additional diversification of funding sources.[59] Globalization might have led to a weakening of the transmission channel by decreasing real and natural interest rates (i.e., real interest rates consistent with stable inflation and output at its potential). As the global economy becomes more and more financially integrated, real interest rates have declined across a wide set of center economies as well as numerous semi-periphery economies (Holston et al., 2017; Del Negro et al., 2017; Neri and Gerali, 2019; Wang, 2019). Although there are several competing hypotheses about the drivers of this global downward trend in natural and real interest rates (Rachel and Smith, 2015), most of the literature has linked financial integration with the downward trend.[60] This downward

the main causes of variation in the impact of monetary policies on economic activity.

[58]Importantly, for sake of conciseness, two monetary policy transmission channels are ignored in this discussion: the portfolio balance (or monetarist) and risk-taking channels. Likewise, the impacts of globalization on monetary policy effectiveness through the creation of IPNs and the rise of inequalities are not cover for conciseness.

[59]This third argument is discussed below in parallel with its impacts on the credit channel.

[60]Three hypotheses are worth mentioning. First, the pool of savings that demands safe assets as a store of value and financial insurance has multiplied as a result of financial globalization while the supply of safe assets has not grown as fast. The strong growth of semi-periphery economies coupled with high savings demand has led to rising scarcity of safe assets and therefore has put downward pressure on interest rates (Bernanke, 2005; Caballero et al., 2016, 2017; Del Negro et al., 2017; Del Negro et al., 2019). Second, over the past three decades a rise in trade openness has been generally matched by a fall

trend in natural rates increases the likelihood of hitting the zero lower bound, making accommodative monetary policy more complicated as it limits the transmission of policy rate cuts to bank funding costs.

Impact of global financial cycle on interest rates and asset prices

Financial globalization has increased and amplified the influence of global factors on long-term interest rates and asset prices, and therefore on the interest rate pass-through. A central argument is that due to global financial cycles (non-US) central banks partially lose the ability to control domestic long-term interest rates which are the central element of the interest rate channel (e.g., see Shin, 2012; Miranda-Agrippino and Rey, 2015; Passari and Rey, 2015; Bruno and Shin, 2015; Rey, 2015, 2016; Georgiadis and Mehl, 2016). While this debate has been particularly heated in semi-periphery economies, it also concerns center economies. As an illustration, Rey (2015) and Miranda-Agrippino and Rey (2015) highlight the existence of a global factor driving a global cycle in capital flows that constrains national monetary policies irrespective of the exchange rate regime.[61] In this context, Chapters 2 and 3 empirically examine whether medium-term cycles in center economies have affected financial conditions in semi-periphery economies. Specifically, Chapter 2 confirms the significance of the medium-term cycles in explaining financial flows to semi-periphery countries. As mentioned above, the presence of large spillovers has been highlighted by the literature (Montecino, 2018; Ca' Zorzi et al., 2020, 2021; Breitenlechner et al., 2021). For example, Mehrotra et al. (2019) document large spillovers from the US long-term rates to center and semi-periphery countries. In that regard, Chapter 4 supports the view that international spillovers are not only large but have also been rooted in rising economic integration.

Global financial cycles have also impacted the credit and wealth effect channels. The

in the world natural rate. Third, the decline in interest rates may also be due to shifts in demographics and slowdowns in trend productivity growth in center economies (Natal and Stoffels, 2019; Comin and Johnson, 2020) (e.g., see Holston et al., 2017; Rachel and Smith, 2018).

[61] While explaining around a quarter of the variation for some *net* financial flows, Cerutti et al. (2019) provide a recent more reserved interpretation on the influence of the global financial cycle.

credit channel can be defined as the impact of monetary policy via changes in the supply of bank loans, via monetary policy-induced changes in funding costs or balance sheet effects of banks, and the demand of bank loans, via monetary policy-induced changes the value of the assets that non-financial corporations can post as collateral. The *wealth effect channel* rests on the ability of monetary policy to affect consumption and investment via changes in asset prices and the value of outstanding debt directly through asset purchases or indirectly via changes in interest rates. In this context, two arguments must be added regarding the influence of global financial cycles on asset prices. On the one hand, global financial cycles have been shown to cause large fluctuations in asset prices (Miranda-Agrippino and Rey, 2015, 2020).[62] On the other hand, financial deregulation and openness have entailed a rise in large medium-term financial cycles in center economies which affects monetary policy effectiveness (e.g., see Borio, 2014, and Chapter 2). This argument is in line with the views, expressed in the Greenspan doctrine, that raising interest rates may be ineffective in restraining financial bubbles because market participants expect such high rates of return from buying bubble-driven assets. In that regard, Fratantoni and Schuh (2003) suggest that monetary tightening is less effective when the economy is experiencing housing booms as the willingness to lend and borrow becomes more connected to the evolution of housing prices than monetary policy rates.

Wealth effect channel

This transmission channel has also been attenuated by the types of distribution and composition of household financial assets that financial deregulation has promoted (i.e., more wealth inequality and stock-market oriented wealth). Indeed, it has been shown that wealth effects are substantially larger for housing than for the stock market (e.g., Carroll, 2004; Carroll et al., 2011; Ciarlone, 2011; Peltonen et al., 2012). Specifically, Carroll et al. (2011) estimate that the long-term marginal propensity to consume out of non-stock-

[62]For example, Miranda-Agrippino and Rey (2020) record that around 20% of the changes in risky asset prices is accounted for by variations in only one global factor. This indicates that foreign and/or global conditions attenuate the effectiveness of the interest rate channel by influencing asset prices in a way that might be uncorrelated to domestic macroeconomic conditions.

market wealth has been more than twice as large as of stock-market wealth. This also implies that cycles in housing prices have a large effect on aggregate demand, and therefore on monetary policy.[63] Finally, monetary policy primarily affects domestic asset valuations. As a greater share of domestic portfolios and agents' wealth is accounted for by foreign assets due to financial integration, the impact of monetary policy on domestic wealth has declined. Therefore, the monetary policy-induced wealth effect has been deteriorated by globalization.

Credit channel, global banking, and funding diversification

The rise of international banking has also entail forces that affected the credit channel. Financial globalization might have led to a weakening of the interest rate and credit channels by permitting additional diversification of funding sources. By easing international liquidity management, financial globalization has weakened the effect of monetary policy through the credit channel. International banks may insulate domestic borrowers from liquidity shocks induced by a domestic monetary policy tightening by transferring liquidity from abroad within the banking group. Global banks may also diversify more internationally their funding and thereby insulate interest rates charged on borrowers when domestic monetary policy is adjusted (Schnabl, 2012; Cetorelli and Goldberg, 2012; Cao and Dinger, 2018). Moreover, globally active banks are more likely to transmit external financing conditions to the domestic economy. For example, Cetorelli and Goldberg (2012) provide evidence that US global banks' use of internal liquidity markets neutralises the effect of changes in US monetary policy on their domestic loan supply. Therefore, the authors suggest that global banks are instrumental in the transmission of US monetary policy and financing conditions internationally. Likewise, Montecino (2018) supports the hypothesis that international monetary spillovers are sizable and are amplified by gross

[63] Note that while Peltonen et al. (2012) and Ciarlone (2011) suggest a significant wealth effect even in semi-periphery countries – especially for housing prices –, Calomiris et al. (2009) contrast with the perspective and suggest that, for the US, "*[o]nce we control for the endogeneity bias resulting from the correlation between housing wealth and permanent income, we find housing wealth has a small and insignificant effect on consumption.*"

bilateral banking connections. Similarly, foreign banks can compensate for a reduction in lending by domestic banks. As a greater share of domestic lending originates from branches and subsidiaries of foreign banks, the credit channel might be weakened.[64]

The importance of these arguments should not be overstated as other pieces of evidence suggest that lending behaviours of globally active banks' subsidiaries and branches are more closely related to local conditions than to those of their owner-specific counterparts (Temesvary et al., 2018; Avdjiev et al., 2018). In the same vein, financial globalization might have actually strengthened monetary policy effectiveness through the credit channel as banks can more easily rebalance their portfolios away from domestic borrowers when their net worth deteriorates, which can amplify the tightening of domestic financial conditions. This could have the double effect of reinforcing monetary-policy-induced as well as non-monetary-policy-induced tightening on domestic financial conditions. Especially, it has been found that when a tighter monetary policy is implemented and erodes the net worth and collateral values of domestic borrowers, globally active banks rebalance claims towards safer foreign borrowers (Correa et al., 2022).[65]

Exchange rate channel

The *exchange rate channel* can be defined as the impact of monetary policy on international relative prices which triggers an expenditure switching effect and thereby accentuates the effects of other monetary policy transmission channels on domestic economic activity and inflation. Globalization seems to have modified the transmission of monetary policy by strengthening the importance of this channel.

The hypothesis that globalization has reinforced the exchange rate channel is based on three arguments. Firstly, exchange rates have been increasingly responsive to mone-

[64]See Buch et al. (2019) for a survey on international transmission of monetary policy through banks.

[65]While weakly significant, Fuentes (2006) also documents that local financial institutions seem to diminish the negative impact of a monetary policy tightening on regional activity in Spain. The explanation is worth mentioning. The authors suggest that local banks "tend to concentrate their lending within the region boundaries, and lending is usually by far their most important business, they might have incentives to avoid excessive short term cyclical turns in their customers' solvency and profitability [...], and focus instead on long term (not cyclical) profitability and lending relationships."

tary policy. Financial globalization, by lowering transaction costs, has accentuated the interconnection between financial markets which in turn has increased the responsiveness of the relative demand for domestic and foreign assets to differentials in their expected returns. Recent empirical evidence supports this effect for the US dollar (Gust et al., 2010; Curcuru et al., 2018; Ferrari et al., 2021) and euro exchange rates (see Jarociński, 2022). Secondly, both center and semi-periphery economies have been increasingly net long in foreign currency on their external balance sheets due to financial globalization (e.g., see Burger et al., 2012, 2015; Bénétrix et al., 2015; Benetrix et al., 2020).[66] Therefore, a tightening of local monetary policy cause a fall in its net foreign asset position, which in turn implies a negative wealth effect. In this context, Georgiadis and Mehl (2016) argue that financial globalization might have strengthened the exchange rate channel through a net foreign currency exposure effect.[67] Thirdly, trade globalization has also played a role in amplifying the exchange rate channel as the consumption basket has been increasingly sensitive to exchange rate. It contributed to an expansion of services in international trade, which in turn accentuated the exchange rate channel as prices for services imports have been shown to be more sensitive to variations in exchange rates (Smith et al., 2004; Eichengreen and Gupta, 2013; Cheung and Sengupta, 2013; Cole et al., 2016). Trade globalization has also entailed a rise in the share of imported goods in the total consumption basket in center countries so that the net export adjustments to monetary policy have became quantitatively more important.[68] Firms' behaviors have evolved in reaction to trade globalization. They may have become more sensitive to market share losses when their prices rise relative to competitors and, as a consequence, domestic producers lower (more) their prices adjust their prices to exchange rate changes (Cwik et al., 2011)

Two counterarguments must be mentioned. Firstly, imported prices in domestic cur-

[66]On both the foreign asset and the foreign liability side, the most foreign currency positions remain denominated in US dollars by far.

[67]On average, the aggregate net foreign assets denominated in foreign currency as a ratio of total assets and liabilities is lower for semi-periphery economies than center economies. In addition, Eurozone countries have substantially lower net foreign currency exposures on average than other center economies. Therefore, this effect is likely to be particularly important for non-Eurozone center economies.

[68]More empirical evidence is needed to judge the quantitative importance of this effect.

rency tend to be less sensitive to exchange rate variations. This effect has mostly been identified for the center economies (Campa and Goldberg, 2005; Ben Cheikh and Rault, 2016, 2017; Ortega and Osbat, 2020) and evidence suggests high level of heterogeneity between countries (Barhoumi, 2006; Brun-Aguerre et al., 2012). The reduction in the sensitiveness of imported prices to exchange rate changes can be the product of several factors associated with globalization (Chung, 2016; Bonadio et al., 2019; Georgiadis et al., 2020; Amiti et al., 2022).[69] Secondly, globalization seems to have increased the sensitivity to the US dollar exchange rate. The development of international banking might have induced a greater sensitivity of banking activities to fluctuations in exchange rates relative to large economies, and in particular the US (Shin, 2012; Bruno and Shin, 2015).

1.3.3 Other impacts on monetary policy

Economic globalization has not only influenced the transmission but also several other dimensions of monetary policy. Notably, Rey (2015) has claimed that the Mundell trilemma has morphed into a dilemma between capital mobility and monetary policy autonomy due to the development of financial globalization. This study opened a vast debate on the literature on the empirical validity of the Mundell trilemma (e.g., see Passari and Rey, 2015; Klein and Shambaugh, 2015; Obstfeld, 2015; Kharroubi and Zampolli, 2016; Aizenman et al., 2016; Rey, 2016; Caceres et al., 2016; Disyatat and Rungcharoenkitkul, 2017; Bekaert and Mehl, 2017). Recent results tend to (partially) confirm the core argument invoked by providing evidence that globalization has reduced the effectiveness of the floating exchange rate regime in isolating the domestic economy against financial pressures (Han and Wei, 2018; Ligonniere, 2018; Cheng and Rajan, 2020).

[69] Trade globalization has increased the level of competitiveness between firms which implies that exporters may have become more prone to adjust their profits to monetary policy to keep their prices stable in the local currency and competitive in the domestic market. Rising economic integration might have induced a switch from producer to local currency pricing settings (see Chung, 2016; Bonadio et al., 2019; Amiti et al., 2022, for empirical evidence). Yet because the overwhelming share of world trade is invoiced in very few currencies, this reduction concerns only a few countries. Last, the development of IPNs might have contributed to the decline in sensitivity of the exchange rate channel as suggested by Georgiadis et al. (2020). The export gains from the decline of the currency is partially offset by the rise in imports incorporated in the exports, decreasing the exchange rate sensitivity of the net export adjustments.

The rising economic integration of these last decades has also impacted central bank cooperation. In that regard, four crucial dynamics can be highlighted. Firstly, with the generalized abandonment of an international fixed exchange rate monetary system, the IMF had to adjust its role in exchange rate management (Yago et al., 2015; Ahmed et al., 2018; Vries, 1986). Since then, IMF members have been almost entirely free to choose any form of exchange arrangement they wish: allowing the currency to float freely, pegging it to another currency (or a basket of currencies), adopting the currency of another country (notably the US dollar), participating in a currency bloc, etc. Likewise, central bank cooperation progressively shifted from monetary to financial stability, and new tools were introduced in the post-Bretton Woods years (Borio and Toniolo, 2006).[70] Secondly, the creation of the ESCB implied large and constraining monetary policy agreements that conflicted with the national monetary policy autonomy (James, 2012). Third, both the 2007-9 GFC and the COVID-19 crisis have shown that central banks can speak and work together. Central banks acted repeatedly in concert during these troubled periods.[71] In line with the findings in Chapter 4, it can be conjectured that economic globalization has been marked by rising monetary cooperation after the GFC, which has led to a rising reactivity of central banks to their peers' monetary condition (especially their economic partners). Lastly, currency swap lines between central banks of center and semi-periphery economies have also emerged as a new important part of the global financial architecture with implications for monetary policy (Bahaj and Reis, 2018, 2020). These swap agreements are likely to have increased the room of manoeuvre of central banks.

Empirical evidence suggests that the influence of tax havens has risen as a growing share of wealth has been managed by offshore financial institutions (e.g., Zucman, 2021). Likewise, transfer pricing techniques by MNEs have been shown to led to tax revenue losses (e.g., Liu et al., 2020; Cristea and Nguyen, 2016). Trade and financial globalization

[70] On the one side countries had more freedom to choose their foreign exchange rate regime and on the other side this evolution unleashed large balance-of-payment difficulties.

[71] One of the best illustrations of this unprecedented cooperation is the joint announcement of an interest rate decrease that followed Lehman's bankruptcy on October 8^{th}, 2008, that was issued by the Bank of Canada, the Bank of England (BoE), the ECB, the Fed, Sveriges Riksbank and the Swiss National Bank, with the support of the Bank of Japan (BOJ).

has certainly eased the implementation of transfer pricing and the development of offshore financial centers. Indeed, globalization has been intimately linked with the outburst of financial offshore centers and networks of tax havens as well as the surge in intra-firm transactions (e.g., see Helleiner, 1994; Burn, 2006; Lanz and Miroudot, 2011b; Chavagneux et al., 2013). This has multiple implications for monetary policy. First, the opacity created by these offshore centers prevent central banks and regulators from assessing the financial health of financial institutions under their supervisions. Therefore, central banks are less capable of implementing informed decisions due to this opacity (Nanto, 1998; Nesvetailova, 2007). Secondly, this evolution may have damaged capital control policy effectiveness. Researchers specialized on tax havens and offshore finance have pointed out that capital control policies are made ineffective by financial globalization (Chavagneux et al., 2013). Specifically, only a sufficiently strong administration (like in China today) would be able to implement capital control policies to efficiently stop capital flight.[72] The ineffectiveness of capital control seem to have decreased for semi-periphery and periphery countries due to the networks of tax havens promoted by globalization.[73]

1.4 Thesis Structure

This thesis is composed of three empirical studies, each assessing a dimension of the influence of economic globalization on financial interdependencies. Chapters 2 and 3 document the financial impact that macroeconomic medium-term cycles in center economies have respectively on waves of short-term financial flows and balance-of-payment difficulties in semi-periphery economies. Chapter 4 analyzes the influence of globalization on the conduct of monetary policy. More specifically, the rest of this manuscript is organized as follows:

Chapter 2 - Medium-term cycles and short-term financial flows. This analysis studies how medium-term financial and industrial cycles in center economies, also

[72]Even the Chinese government has struggled to do so in 2014-2015.

[73]My work on this topic provided preliminary findings that tend to confirm this hypothesis.

called CLIF cycles, trigger large countercyclical short-term financial inflows (bank loan and portfolio investments) in semi-periphery countries. First, a portfolio optimization model in the presence of CLIF cycles shows that the emergence of a pattern of cyclical short-term financial flows results from three core factors. It can be caused by (i) a high procyclical sensibility of the semi-periphery to the medium-term cycles in the center, (ii) a large substitution effect (i.e., financial investors shift out of center economies during the downward phases of the cycles), or (iii) a large volume effect (symbolizing the variations of the overall amount invested in the global economy throughout the cycles). The model indicates that short-term financial flows to semi-periphery countries are countercyclical to the CLIF cycles if the substitution effect dominates the volume effect. Second, an estimation strategy is deduced from the theoretical model to statistically assess the existence of a pattern of cyclical international short-term financial flows to semi-periphery economies driven by the CLIF cycles since the 1970s. The findings suggest that (i) portfolio flows to semi-periphery countries are countercyclical to the CLIF cycles, (ii) FDI flows are not affected as much as shorter-term financial flows, (iii) financial flows to periphery countries tend to be procyclical, and (iv) center economies have a large and heterogeneous influence on their financial and trade partners.

Chapter 3 - Medium-term cycles and balance-of-payment crises.[74] This study complements the analysis developed in Chapter 2 by modeling how the cyclical pattern of international short-term financial flows to semi-periphery countries contributes to induce waves of BOP crises in these economies. This contribution enables us to account for (i) a periodic pattern characterizing international financial flows between center and semi-periphery economies since the 1970s, and (ii) how this pattern is at the root of the BOP crises in semi-periphery countries. To confirm the more general model introduced, this chapter proposes a historical review of the main balance-of-payment difficulties of semi-periphery countries since the 1970s. Three

[74] This study co-authored with Jean-Christophe Defraigne.

periods (1970-90; 1991-2001; 2002-2019) are distinguished regarding the evolution of the nature, magnitude and, impact of international financial flows between center and semi-periphery countries. We show that for every period the downward phase of CLIF cycles triggered considerable financial inflows to the semi-periphery and created condition for three waves of BOP crises in these economies in 1980-1990, 1994-2002, and 2007-2018.

Chapter 4 - Monetary Policy Spillovers.[75] This chapter examines international monetary policy spillovers over the past four decades. To assess these spillovers, we rely on observations of a large cross section of monetary policy rates at a monthly frequency. Under reasonable assumptions, we are able to disentangle the evolution of spillovers driven by changes in the economic relationship between countries (the intensification of globalization) from those driven by changes in how these countries react to foreign factors (sensitivity of monetary policy decisions in response to other central banks' policies at a given integration level). We do so by estimating a time-varying spatial regression model based on maximum likelihood and local kernel techniques. Our results indicate that spillovers are sizable and have increased considerably since the 1980s, suggesting that countries have partially lost their monetary autonomy. However, this result hides heterogeneous patterns. While economic integration increased markedly during this period, central banks tended to react less, for a given level of integration, to foreign policies. Exploring the role of the Fed, our results support the existence of a multipolar, rather than unipolar, system over the entire period, particularly after the 2008 GFC.

Chapter 5 - Conclusion. This last chapter concludes by discussing the core findings obtained in the previous chapters and highlights some further research perspectives.

[75]This study is co-authored with Alexandre Girard and Jean-Yves Gnabo.

2 | Medium-term cycles and short-term financial flows

Evidence of countercyclicity between the CLIF cycles and short-term financial inflows to semi-periphery economies

Abstract

This study assesses the existence of a pattern of short-term financial flows to semi-periphery economies driven by medium-term cycles in center countries, the CLIF cycles. First, a portfolio optimization model discusses how investors' adjustments to these cycles generate a pattern of cyclical short-term financial flows. Financial inflows to semi-periphery countries evolve countercyclically to medium-term cycles in presence of a large substitution effect (i.e., financial investors shift out of center economies during the downward phases of the cycles). However, this effect competes with a volume effect, symbolizing the variations of the overall amount invested in the global economy. Second, an estimation strategy for the period 1970-2020 is deduced from the theoretical model. Third, the empirical findings indicate that (i) portfolio investments to semi-periphery countries are countercyclical to the medium-term cycles in center economies, supporting the existence of a strong countercyclical substitution effect, (ii) FDI flows are not affected as much as shorter-term financial flows, (iii) financial flows to periphery countries tend to be procyclical, and (iv) financial and trade connections with center economies tend to accentuate the effect of the cycles.

Contents of the chapter

2.1 Introduction

This study explores whether medium-term cycles in major center (advanced) countries that emerged in the 1970s, called the Center Leader economies' Industrial-Financial cycles (CLIF cycles), are crucial drivers of a pattern of international financial flows to semi-periphery (emerging and developing) economies. The influence of large economies on rapid changes in international financial flows has drawn attention from academic literature (Rey, 2015, 2016; Adler et al., 2016; Fofack et al., 2020; Shim and Shin, 2021; Matsubayashi and Kitano, 2022), central bankers,[1] international financial institutions (e.g., BIS, 2021; IMF, 2021),[2] and specialized newspapers[3] amid rising concerns that changing macroeconomic conditions in the US and Europe could lead to a new "taper tantrum" and disruptive international financial flows for semi-periphery economies.

From a macroeconomic perspective, an important question is the identification of domestic and international factors at the origin of swift asset reallocations. In this respect, two important conclusions from academic literature are worth mentioning. First, global factors or shocks have had important effects on financial flows and economic activity in semi-periphery economies (e.g., Miranda-Agrippino and Rey, 2015; Obstfeld et al., 2018; Dées and Galesi, 2021; Davis and Zlate, 2022). Notably, these elements have been addressed in several former studies on sudden stops (e.g., Reinhart and Calvo, 2000; Edwards, 2004; Forbes and Warnock, 2012; Ghosh et al., 2016; Adler et al., 2016). Second, the global financial liberalization that started in the 1970s in center economies has been shown to be a factor at the origin of large and more synchronized medium-term cycles (Claessens et al., 2011; Borio, 2014; Zelazowski et al., 2016; Jordà et al., 2017). Surprisingly, while

[1] See Parkin B. "Pakistan's central bank chief warns of taper tantrum-style shock to emerging markets," *Financial Times*, November 23, 2021. We can also refer to financial stability reports of the largest central banks (Board of Governors of the Federal Reserve System, 2022; ECB, 2021).

[2] See also Smith C. and Wheatley J. "Emerging economies cannot afford 'taper tantrum' repeat, says IMF's Gopinath," *Financial Times*, August 29 2021.

[3] As illustrations, see Otaviano Canuto, "Will another taper tantrum hit emerging markets?", *Brookings* July 15 2021; Douglas J. et al., "Rising Inflation and Interest Rates Heap Pressure on Emerging Markets," *The Wall Street Journal*, June 18, 2022; Duguid K., "Emerging markets hit by record streak of withdrawals by foreign investors," *Financial Times*, July 31, 2022; Loh L., and Blanchard B., "Taiwan central bank says it will not adopt foreign exchange control measures," *Reuters*, September 28, 2022.

medium-term cycles in major center economies are discussed as key components of domestic macroeconomic conditions (IMF, 2008a; Borio, 2014; Aikman et al., 2014), their impacts on international financial flows to semi-periphery economies has received limited attention. The main purpose of this study is to fill this gap by estimating medium-term cycles for key center economies since the 1970s, based on the methodology introduced in Drehmann et al. (2012) and Borio (2014), and assessing their impacts on international financial flows to semi-periphery economies. Overall, the main questions I address can be expressed as follows: Through their adjustments to macroeconomic conditions in center economies, do global investment strategies by center countries' investors (contribute to) induce large cyclical international financial flows to semi-periphery countries? and if so, are these financial flows procyclical or countercyclical to the CLIF cycles? Does this dynamic concern all types of financial flows? Do medium-term cycles also affect periphery countries in a similar manner?

In summary, I first model how adjustments by international investors to macroeconomic medium-term cycles contribute to generate a cyclical pattern in international financial flows to semi-periphery countries. Second, relying on this model and weak assumptions, I propose an identification strategy to empirically test a few key hypotheses. Using this framework, I suggest some answers to the questions mentioned above regarding the impacts of medium-term cycles on international financial flows since the 1970s.

Based on empirical indicators of the CLIF cycles for the US, Japan, Germany, France, and the UK, the econometric results indicate that financial inflows to semi-periphery countries (especially bank loan and portfolio investments)[4] are countercyclical to the CLIF cycles since the 1970s.[5] As an illustration, Figure 2-1 exhibits an estimate of the GDP-weighted mean of the CLIF cycles and the aggregation of all financial inflows to semi-periphery economies between the 1970s and late 2010s. These curves suggest that the two macroeconomic dynamics move in opposite directions, which is confirmed by my empirical

[4]This also holds when considering the aggregate of all financial flows in the balance-of-payment data.

[5]In other words, when center countries experience the downward phases of their medium-term financial and industrial cycles, it results from these cycles that financial inflows to semi-periphery countries tend to increase on average.

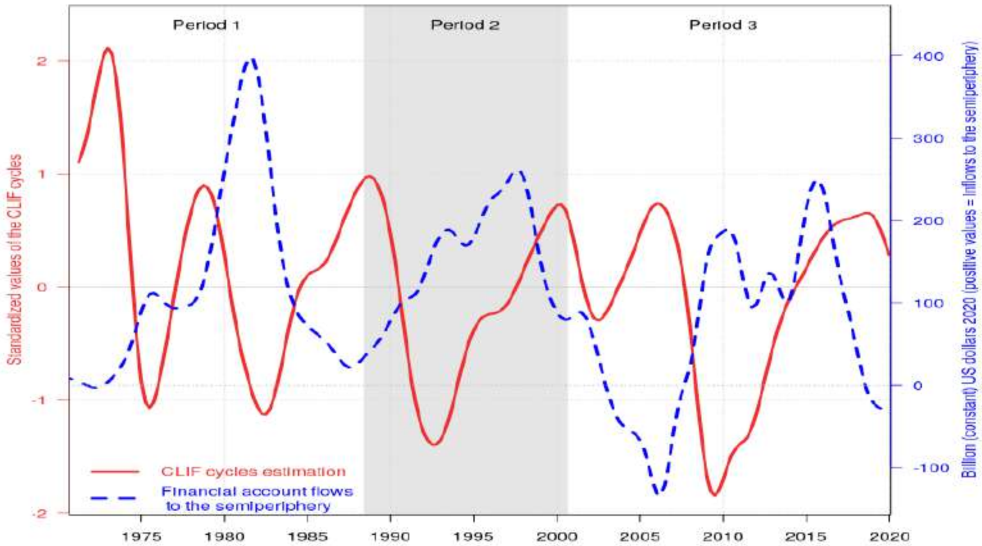

Figure 2-1: CLIF cycles and financial flows to the semi-periphery

assessments. Using different networks of interaction between countries, the empirical results also support that semi-periphery countries with strong financial connections with center economies are more likely to experience larger countercyclical financial inflows. By contrast, trade relations tend to compensate this pattern, and can lead to procyclical financial inflows for semi-periphery countries with very high level of trade openness and integration with the center economies. FDIs are not nearly as affected by the medium-term cycles as portfolio investments (if anything, they tend to evolve procyclically). In addition, the results suggest that the financial flows to *periphery* countries tend to be procyclical (in contrast to semi-periphery countries).

The remainder of this study is organized as follows. Section 2.2 develops a two-country model, introduces the methodology and data, and discusses the empirical results for the aggregate effect. The study is extended in Section 2.3 with a multipolar model and the corresponding empirical analysis of the transmission channels. Empirical results incorporating various heterogeneities (across countries, periods, and types of financial flows) are examined in Section 2.4. Section 2.5 concludes.

2.2 Two-country model and aggregate effect

This section analyses the impact of medium-term cycles in center economies on international short-term financial flows between the center and semi-periphery *considered as a whole*.[6] It starts by developing a two-country portfolio optimization problem in Section 2.2.1. Section 2.2.2 details the methodology. Data are introduced in Section 2.2.3. Sections 2.2.4 and 2.2.5 respectively discuss the core empirical findings and robustness checks.

2.2.1 Portfolio optimization problem

I consider a portfolio optimization problem of an investor i that has to reinvest their funds between the semi-periphery and the center (the "two countries") at every period t.[7] This investor searches the maximum return of their investment in $t+1$, noted $R_{i,t+1}$. Therefore, investor i has to determine the optimal share of their funds to invest in the center, noted $\theta_{cit} \in [0,1]$, and in the semi-periphery, θ_{sit}, with $\theta_{sit} + \theta_{cit} = 1$. Noting $\boldsymbol{\theta}^*_{it} = \{\theta^*_{sit}, \theta^*_{cit}\}$, the decision-making problem that the investor i faces in t can be written as follows:[8]

$$\boldsymbol{\theta}^*_{it} = \underset{\boldsymbol{\theta}_{it}}{\operatorname{argmax}}\, \mathcal{O}(\boldsymbol{\theta}_{it}) \quad \text{with} \quad \mathcal{O}(\boldsymbol{\theta}_{it}) \equiv E\left[R_{i,t+1}(\boldsymbol{\theta}_{it}) - \lambda_i Risk_{i,t+1}(\boldsymbol{\theta}_{it})\,|I_{it}\right] \tag{2.1}$$

where $Risk_{it}$ is a function used by the investor to promote a diversification strategy in order to diminish the risks (e.g., default risk), λ_i is a risk-aversion coefficient indicating how much the investor is risk-averse and values diversification, and I_{it} is the information available by the investor i in t. The return function is the product of the returns of each

[6]Section 2.3 considers a multipolar approach and develops a N-country portfolio optimization model to study the transmission channels as sources of heterogeneities.

[7]The fact that the investor re-allocate their portfolio at every period aims at exclude the transaction costs from the analysis in order to simply the problem, and does not change the core results.

[8]This is a mean-variance optimization scenario, which offer good approximations to most common portfolio utility functions (see Levy and Markowitz, 1979; Markowitz, 1991; Das et al., 2010, for more details).

of the two investments, that is $R_{i,t+1} = \theta_{sit} r_{s,t+1} + \theta_{cit} r_{c,t+1}$ where r_{st+1} and r_{ct+1} are the respective returns in the semi-periphery and the center. I consider here the percentage return such that the total return is given by the product of $r_{i,t+1}$ by amount invested q_{it}. The risk function is promoting a diversification strategy and modeled as a weighted sum of the squared shares: $E\left[Risk_{i,t+1} \left| I_{it}\right.\right] = \frac{1}{2}\left(\sigma_{sit}\theta_{sit}^2 + \sigma_{cit}\theta_{cit}^2\right)$, with σ_{sit} and σ_{cit} two exogenous indicators of how the investor i perceives the relative average risk to invest in the areas. All other things being equal, the higher σ_{sit} is, the more the semi-periphery is perceived as at risk, and the larger the investments to the center are. The sum $\sigma_{sit} + \sigma_{cit}$ is normalized to one. Therefore, λ_i captures the overall risk-aversion and σ_{sit} represents only the *relative* risk to invest in the semi-periphery.

An investor can form their expectations of the returns $r_{s,t+1}$ and $r_{c,t+1}$ in different ways. I model these returns are functions of the CLIF cycles, noted A_t. Other factors are considered as exogenous and included in terms κ_{cit} and κ_{sit} for the center and the semi-periphery respectively. For the center, I assume that $E_i\left[r_{c,t+1}\right] = \kappa_{cit} + f_i(A_t)$ with f_i a function that monotonically increases with the CLIF cycles, that is $f_i' = \frac{d}{dA_t} f_i > 0$. The time difference between two periods (e.g., 6 months) is viewed as small relative to the average wavelength of the CLIF cycles (around 10-15 years). The investor i is aware of the cycles but does not impact them.[9] For the semi-periphery, I model the expectation as follows:[10]

$$E_i\left[r_{s,t+1}\right] = \kappa_{sit} + \eta_i\theta_{sit} + \epsilon f_i(A_t) \tag{2.2}$$

In addition to assume that the return is a function of A_t, I also consider the amount

[9] An alternative choice in the modeling of the expectations consists in using as-simple-as-possible adaptive expectations, that is a tomorrow-will-be-as-today forecast. For the center, this involves that $E_i\left[r_{c,t+1}\right] = r_{ct}$. This is useful as it shows that there is not need to suppose the awareness by investors of the impact of the CLIF cycles to get similar results. Indeed, in such cases $E_i\left[r_{c,t+1}\right] = \kappa_{ct} + f(A_t)$ and the impact of A_t is the same. The main key difference (which explain why I kept the more sophisticated model) is that κ_{ct} and f are common among the investors, while I enable them to have diverse expectations. In such case, this implies that for the semi-periphery the term related to η_i would be incorporated in the more general term that is κ_{cit}. Another common option would be to model accurate (rational) forward-looking forecasts such that $E_i\left[r_{c,t+1}\right] = r_{c,t+1}$. Because I focus on the longer-term effects of the CLIF cycles, the differences between these modelings can be ignored.

[10] I chose to model the influence of A_t using the same function for simplicity. Yet, the results can be extended to a more general pattern where $\epsilon f_i(A_t)$ is replaced by $g_{it}(A_t)$ without changing the key points.

invested in the area as a potential driving force (e.g., due to a wealth effect it might contribute to generate).[11]

For simplicity, θ_{sit} is assumed to evolve between 0 and 1, but never to reach such extreme values; $0 < \theta_{sit} < 1$. In addition, the parameters must be such that $\lambda_i > 2\eta_i$ for the objective function $\mathcal{O}$ to be concave. Under such conditions, the solution to the maximization problem is given by:[12]

$$\theta^*_{sit} = \underbrace{\frac{\lambda_i - \lambda_i\sigma_{sit} + (\kappa_{sit} - \kappa_{cit})}{\lambda_i - 2\eta_i}}_{= \ \delta_{0,it}} + \underbrace{\frac{-(1-\epsilon)}{\lambda_i - 2\eta_i}}_{= \ \delta_{1,it}} f_i(A_t). \tag{2.3}$$

A few key features emerge from this relation. Firstly, if the expected returns in the semi-periphery are highly procyclical with the CLIF cycles (e.g, due to large trade and financial exposures and openness to the center) such that ϵ is high, the impact of the cycles is diminished. In an extreme scenario, the investment share can even increase procyclically with the CLIF cycles.[13] Assuming that the returns in the semi-periphery is not procyclical and massively dependent on the CLIF cycles (i.e., $\epsilon < 1$, so that $\delta_{1,it} < 0$), the share of investments decreases countercyclically with the CLIF cycles. This comes from the hypothesis that the returns in the center are more driven by the CLIF cycles then that of the semi-periphery. Therefore the investor has more incentive to invest in the semi-periphery when the returns in the center decrease. If the returns in the semi-periphery increases countercyclically with the cycles (e.g., due to a countercyclical increase in local

[11]Three situations relative to the role of the amount of investment on the returns can be introduced. First, investor i considers that they has no (or marginal) impact on the total investment in the area, $Q^s_t = \sum_i q_{it}\theta_{sit}$, and that their own strategy do not affect Q^s_t (which it at the root of the wealth effect dynamic), therefore their expectation is similar to the situation where $\eta_i = 0$ (Q^s_t is exogenous) and influence of other investor is included in κ_{sit}. Second, investor i considers that they has a key influence on the economy receiving their funds (large flows relative to absorption capacity), such that they assumes that $Q^s_t \approx \theta_{sit}q_{it}$ (this is not very plausible at the scale of the whole semi-periphery, but might be useful for considering cases of small economies). In this case, η_i can be substantial. Third, investor i forecasts that they has no impact (or marginal) on Q^s_t but that their strategy is very close to other investors strategy such that $Q^s_t \approx k\theta_{sit}q_{it}$ with k an exogenous and constant scalar and $\eta_i = kq_{it}$. These cases can all be formulated into the model, with different values for η_i.

[12]See Appendix A.1.1 for the demonstration and details. The extreme cases with $\theta_{sit} = 0$ or 1 are incorporated and discussed in this appendix.

[13]While this is a possible scenario, the empirical results do not support this possibility for the semi-periphery as a whole. Interestingly, my findings support the hypothesis that ϵ is high and financial flows procyclical for periphery economies (see Section 2.4).

speculation), then $\epsilon < 0$, and the countercyclical variation in the investment share to the semi-periphery is even stronger. Secondly, as we can expect, the more risky the semi-periphery is perceived by the investor (high σ_{sit}) and/or the less profitable the investment opportunities in the semi-periphery are (low $\kappa_{sit} - \kappa_{cit}$ throughout the CLIF cycles), the less investment is made in the area. Thirdly, if the investor i is extremely risk-averse (meaning that $\lambda_i \gg \eta_i$, $f_i(A_t)$ and $\kappa_{sit} - \kappa_{cit}$) the solution becomes $\theta^*_{sit} \approx 1 - \sigma_{sit} = \sigma_{cit}$. As expected, the only driving force in the decision is the assessment of the risk in the two areas. Fourthly, the more the returns are pushed up by foreign investments in the semi-periphery (e.g. due to a large wealth effect, low absorption capacities), that is the higher η_i is, the more investments are made in the area $\left(\frac{\partial \theta^*_{sit}}{\partial \eta_i} > 0\right)$ and the more volatile is the optimal investment share for the investor i, θ^*_{sit}.[14] This means that an increase in η_i leads to a rise in the impacts of other determinants on the optimal investment share θ^*_{sit}.

An additional observation regarding the impact of the CLIF cycles on the investment decision through changes in the risk-aversion of the investor can also be deduced. I consider here that the coefficient of risk-aversion, λ_i, and/or the relative assessment of risk between the areas, captured by σ_{sit}, depend on the CLIF cycles. For ease, I assume that $\eta_i = 0$. In this context, the derivative of θ^*_{sit} by A_t can be written as follows:[15]

$$\frac{\partial \theta^*_{sit}}{\partial A_t} = -\underbrace{\frac{\partial \sigma^*_{sit}}{\partial A_t}}_{>0} + \frac{E_i\left[r_{c,t+1} - r_{s,t+1}\right]}{\lambda_i^2} \underbrace{\frac{\partial \lambda^*_i}{\partial A_t}}_{<0} + \delta_{1,it} \underbrace{\frac{\partial f}{\partial A_t}}_{>0}. \tag{2.4}$$

The first term on the right-hand side indicates that during the downward phases of the CLIF cycles the investor i considers the center as increasingly more risky relative to the semi-periphery.[16] The second term in the right-hand side of the equation supports that,

[14] Indeed, we have that sign $\left(\frac{\partial^2}{\partial \eta_i \partial X} \theta^*_{sit}\right)$ = sign $\left(\frac{\partial}{\partial X} \theta^*_{sit}\right)$, with $X \in \{\lambda_i, \sigma_{sit}, \kappa_{sit}, \kappa_{cit}, \epsilon, \eta_i, A_t\}$. Note that this relation only holds when the objective function is concave, that is when $\lambda_i > 2\eta_i$. Another condition must be added regarding the derivatives of θ^*_{sit} with λ_i. If $\theta^*_{sit} < 1 - \sigma_{sit} < 2\theta^*_{sit}$, we have that $\frac{\partial}{\partial \lambda_i} \theta^*_{sit} > 0$ while $\frac{\partial^2}{\partial \eta_i \partial \lambda_i} \theta^*_{sit} < 0$.

[15] This comes from Equation 2.3, after highlighting the terms $r_{c,t+1}$ and $r_{s,t+1}$.

[16] It can be contested that in a context with a large value for ϵ (e.g., for some semi-periphery and periphery countries highly exposed to the center during the downward phase of the CLIF cycles) the investor would "rush to the quality" and σ^*_{sit} would increase countercyclically even if the drops in returns originate from the center because the reduction in expected returns in more drastic for these semi-

as long as the expected returns are higher in the center than in the semi-periphery, the downward phases of the CLIF cycles induces a rise in the risk-aversion of the investor which itself leads to an increase in the investment share to the semi-periphery. As a consequence of these two dynamics, it seems reasonable that (i) the investor adjusts to the relative risk between the areas and (ii) the changes in risk-aversion throughout the CLIF cycles might be additional channels leading to a countercyclicity of the investment share to the semi-periphery θ^*_{sit}.[17]

To obtain the amount invested in the semi-periphery by the investor i, noted ϕ_{sit}, we need to multiple the share θ_{sit} and the total amount of money invested by them, noted q_{it}, such that $\phi_{sit} = q_{it}\theta^*_{sit}$. The total amount of financial investment to the semi-periphery is the sum of the investments for all investors, given by $\phi_{st} = \sum_i \phi_{sit}$. I start by considering q_{it} is exogenous and independent of A_t, then generalized the result. If q_{it} as exogenous and independent of A_t, the investments to the semi-periphery can be express as follows: $\phi_{st} = \left(\sum_i q_{it}\delta_{0,it}\right) + \left(\sum_i q_{it}\delta_{1,it}\right) f(A_t)$.[18] Because $\delta_{1,it} < 0$ (assuming that ϵ is not higher than 1), the financial investments to the semi-periphery evolve countercyclically with the CLIF cycles. Therefore, it is clear the share of investments to the semi-periphery θ^*_{sit} decreases with A_t as well as ϕ_{st} when q_{it} is fixed. Yet, when considering that the amount of capital to invest q_{it} might change throughout the CLIF cycles, the situation is more complex. Considering that q_{it} can be decompose into two components, with only one depending on A_t such that $q_{it} = \tilde{q}_{it} + g_{it}(A_t)$ with $g'_{it} = \frac{d}{dA_t} g_{it} > 0$ and $\frac{d}{dA_t}\tilde{q}_{it} = 0$, the

periphery and periphery countries. The empirical results of this study support this claim, in particular for periphery countries and highly trade connected semi-periphery countries. Yet, it seems less plausible based on these same results that it is the case *for the semi-periphery as a whole.*

[17] For conciseness and simplicity, I focus the analysis on the impact of the variation of f throughout the CLIF cycles. This is based on the hypothesis that this factor is more important than the two other effects introduced in the paragraph. However, these effects seem to reinforce one another such that most conclusions could also apply to these additional factors.

[18] $\delta_{0,it}$ and $\delta_{1,it}$ are defined in Equation 2.3 as $\delta_{0,it} = \frac{\lambda_i - \lambda_i \sigma_{sit} + (\kappa_{sit} - \kappa_{cit})}{\lambda_i - 2\eta_i}$ and $\delta_{1,it} = -\frac{(1-\epsilon)}{\lambda_i - 2\eta_i}$.

variation of ϕ_{st} throughout the CLIF cycles is given by:[19]

$$\frac{\partial \phi_{st}}{\partial A_t} = \underbrace{\sum_i \theta^*_{sit} \frac{\partial q_{it}}{\partial A_t}}_{\text{volume effect}} + \underbrace{\sum_i q_{it} \frac{\partial \theta^*_{sit}}{\partial A_t}}_{\text{substitution effect}} = \underbrace{\sum_i \underbrace{\theta^*_{sit}}_{>0} \underbrace{\frac{\partial g_i}{\partial A_t}}_{\gtrsim 0}}_{>0} + \underbrace{\underbrace{\left(\sum_i \delta_{1,it} q_{it}\right)}_{<0} \underbrace{\frac{\partial f}{\partial A_t}}_{>0}}_{<0}. \quad (2.5)$$

Changes in financial investments to the semi-periphery can be explained by two major effects. On the one side, the volume effect is the procyclical increase in financial investment to the semi-periphery throughout the CLIF cycles caused by the procyclical rise in the amount (volume) of investable financial funds in the center. This effect can be viewed as the changes in financial investments in the semi-periphery when the share of the investments in the two areas is kept constant. It is likely that for most of the financial investors from the center, their ability and willingness to invest increases during the upward phases of the CLIF cycles (that is $\frac{\partial q_{it}}{\partial A_t} > 0$). Even if q_{it} does not increase with A_t for every investor i (symbolized by $\gtrsim$ rather than $>$ in Equation 2.5), because the investors from the center represent the bulk of the investment capacities during the period investigated for this study, the aggregate impact is that the volume effect leads to a procyclical increase in financial investments to the semi-periphery. On the other side, the substitution effect is the countercyclical rise in financial investments to the semi-periphery that results from changes in the investment shares. This can be regarded as a process of substitution between the two areas as places to invest, seeing the total amount invested in the global economy constant. These two effects oppose one another such that a theoretical investigation alone does not propose a definitive answer to the dominant direction of influence of the CLIF cycles on financial investment in the semi-periphery.

Overall, three main scenarios emerge from this model regarding the direction of influence of the CLIF cycles on financial investments to the semi-periphery. The aggregate financial investment to the semi-periphery evolves *procyclically* with the CLIF cycles if the substitution effect is dominated by a considerable procyclicity of the profitability in

[19] See Appendix A.1.2 for details on the decomposition of q_{it}, and the reasons for assuming that $q'_{it} > 0$.

the semi-periphery (i.e., $\epsilon \geq 1$ and therefore $\sum_i q_{it}\delta_{1,it} > 0$). In such a scenario, regardless of the volume effect, the investment to the semi-periphery contracts during the downward phases of the CLIF cycles. In the more reasonable scenario where the profitability of investments in the semi-periphery is not as substantially procyclical ($\epsilon < 1$), the dynamic of the aggregate financial investment to the semi-periphery depends on the respective magnitudes of the volume and substitution effects. The aggregate financial investment to the semi-periphery evolves *procyclically* with the CLIF cycles if the volume effect dominates the substitution effect (i.e., $\sum_i \theta^*_{sit} \frac{\partial q_{it}}{\partial A_t} > \sum_i q_{it} \left| \frac{\partial \theta^*_{sit}}{\partial A_t} \right|$). In this scenario, it is the contractions and expansions of the amount of investable funds that is the driving force explaining the variations in financial investments to the semi-periphery. Alternatively, the aggregate financial investment to the semi-periphery evolves *countercyclically* with the CLIF cycles if the substitution effect dominates the volume effect $\left(\text{i.e., } \sum_i \theta^*_{sit} \frac{\partial q_{it}}{\partial A_t} < \sum_i q_{it} \left| \frac{\partial \theta^*_{sit}}{\partial A_t} \right|\right)$. This scenario suggests that, in period of economy difficulty in the center, substantial financial funds flight out of the area and are invested in the semi-periphery as an alternative to obtain higher returns.[20]

The methodology explained in Section 2.2.2 introduces an identification strategy to determine which of these scenarios illustrates the best the pattern of short-term financial flows between the center and semi-periphery between the 1970s and early 2020s. Based on this methodology, the results discussed in Section 2.2.4 suggest that financial investments to the semi-periphery evolve *countercyclically* with the CLIF cycles, indicating that the substitution effect dominates the volume effect. Before turning to these elements, to provide further support for the empirical strategy, I briefly develop a similar optimization problem with multiple center and semi-periphery countries.

[20]In addition to the primary effect of the differential of returns between the two areas, a procyclical increase in risk-aversion and changes in relative risk-weighting between the areas might increase the countercyclical dynamics, as suggested by Equation 2.4. In addition, we can note that financial investment to the semi-periphery might not be clearly or considerably affected by the CLIF cycles (e.g., due to large and various heterogeneities within semi-periphery countries and financial investors' expectations). Moreover, other factors that have not be highlighted might have a more crucial effect on the evolution of the financial investment pattern between the center and the semi-periphery such that the impact of the CLIF cycles does not emerge as significant.

2.2.2 Methodology

The foundation of the empirical strategy relies on the closed form solution of the optimization problem for a panel data model. The dependent variable, noted ϕ_{nt}, represents international short-term net financial inflows to the semi-periphery country n at period t, with a total of N_s countries. The data generating process (DGP), arising from a linearization of Equation 2.3, can be written as follows:

$$\text{DGP 1}: \qquad \phi_{nt} = \alpha_n + \beta^A A_t + \beta X_{nt} + \varepsilon_{nt} \tag{2.6}$$

where α_n is an unknown country fixed effect parameter and β^A represents the coefficient of influence of the CLIF cycles on international financial investments. As mentioned above, if the profitability of investments in the semi-periphery is very procyclical with the CLIF cycles (i.e, $\epsilon > 1$) and/or that the volume effect is larger than the substitution effect, β^A should be positive. By contrast, considering a small volume effect relative to the substitution effect and $\epsilon < 1$, β^A is negative and equals to $-\left(\sum_i \frac{(1-\epsilon)}{\lambda_i - 2\eta_i} q_{it}\right) \frac{\partial f}{\partial A_t}$.[21] In this equation, X_{nt} is a vector of multiple macroeconomic variables (with details provided in Section 2.2.3) and ε_{nt} is the unknown normally distributed disturbance (or error term) with mean zero and unknown variance. α_n and βX_{nt} capture the domestic factors that could impact the financial flows and are independent of the CLIF cycles.

This empirical strategy relies on assumptions, the main ones of which are explained here.[22] First, the following assumption emerges directly from the portfolio optimization problem:

Assumption 2.1 (A2.1)**.** *The CLIF cycles are exogenous.*

This notably implies that medium-term macroeconomic cycles in semi-periphery and periphery countries impact, at most, modestly the center economies and therefore the CLIF

[21] See Equation 2.5 for details. This model implies a linearization of f, so that $\frac{\partial f}{\partial A_t}$ is a constant.

[22] Documented by empirical evidence, the existence of CLIF cycles and the theoretical relevance of categories of countries are viewed as understandable and practical. They are not considered as assumptions.

cycles. While this assumption might seem strong,[23] based on the respective sizes and developments of their financial markets, it is likely that most of the influence comes from center leader economies.[24] This comes from the fact that the absorption capacities and controls on international investments vary importantly in favor of center countries.[25] Absorption capacity refers here to the amount of external financial resources that a country is capable to manage and spend, actually and efficiently, without producing negative macroeconomic side-effects (e.g., large increase in inflation and/or real effective exchange rate (REER)), within their borders.[26]

Another assumption comes from the modeling of the decision-making process:

Assumption 2.2 (A2.2)**.** *Investors maximize their expected returns in each period independently.*

The assumption that investors are independent of one another and individually optimize their returns (e.g., they are not influenced by other investors' decisions and expectations) does not lead to major difficulties. This is because each investor reacts to changes in CLIF cycles so that they integrate this dimension that reflect some herd behaviors. Additionally, the DGP incorporates several macroeconomic independent variables. Therefore, this modeling choice should not impact the empirical validity of the results. Likewise, the assumption that investors optimize their returns is neither perfectly realistic nor constraint free, but a practical choice with limited modeling and empirical implications. Because short-term financial flows are considered (e.g., portfolio investments), the assumption that investors re-invest at every period can be viewed as equivalent to the assumption that

[23]For example, it is reasonable to consider that the Asian financial crises of 1997-98 could have had a significant effect on the uptrend of the US economy in the late 1990s and early 2000s.

[24]A Granger (non-)causality test was performed to confirm this interpretation. I did not reject the hypothesis of non-causality of the financial flows of semi-periphery countries on the medium-term cycles of center leader countries, while I rejected the hypothesis of non-causality (confirming the potential for causation) of the cycles on the financial flows.

[25]This affirmation can be summarized by the following relation:

$$\frac{\text{international investments by C in SP}}{\text{absorption capacity of SP}} > \frac{\text{international investments by SP in C}}{\text{absorption capacity of C}}, \tag{2.7}$$

with C for center and SP for semi-periphery economies.

[26]As an example, macroeconomic absorption capacity is measured in GDP under the Cohesion Policy rules in the EU limit the transfer of EU funds to a maximum of 3.8 % of the respective country's GDP.

transaction costs are low.[27]

Two additional assumptions emerge from the transition from the theoretical models to the practical estimation of the parameters in DGP 1. The first assumption is related to the volume effect and can be formulated as follows:

Assumption 2.3 (A2.3)**.** *The funds invested evolve procyclically with the CLIF cycles.*

I assume that the total amounts of money invested in the global economy by investors increases during the upward phases of the CLIF cycles to capture the fact that for most investors the total of their expected returns (weighted by the risks) increase during favorable periods in center economies (see Appendix A.1.2 for a further discussion). This reflects a procyclical influence of the medium-term cycles on financial inflows to semi-periphery countries through the volume effect. This assumption does not have a direct influence on the quality of the estimations, yet, it has an indirect effect on the interpretation. Based on this assumption, a negative estimate for β_t^A supports the view of a countercyclical effect of the CLIF cycles on the financial inflows due to a stronger substitution effect relative to the volume effect, while a positive estimate indicates that either the opposite (a stronger volume effect) or a procyclical substitution effect. The second assumption concerns the linerarization process needed to obtain DGP 1:

Assumption 2.4 (A2.4)**.** *Higher order terms of the CLIF cycles can be ignored.*

Large higher order terms ignored due to the linearization process (for example, for the second order, a term proportional to A_t^2) could bias the estimations for β_t^A. However, as cycles model medium-term influences, this simplification should not alter the overall influence and interpretation arising from the proposed empirical strategy.

Conditional to A2.1–2.4, the estimates for the parameters in DGP 1 enable us to empirical assess some hypotheses on the macroeconomic influences of the CLIF cycles on

[27]The transaction costs can be included in the expression of the return $R_{i,t+1}$ as a cost to changes in θ_{sit}. For example, we can consider the new model with the return function given by $R'_{i,t+1} = \theta_{sit} r_{s,t+1} + \theta_{cit} r_{c,t+1} + \tau|\theta_{sit} - \theta_{si,t-1}|$ with τ a positive constant modeling the transaction costs. In such scenario, only a sufficient impact resulting from changes on θ_{sit} but the main conclusion of the model remain unchanged. Logically, this point suggests that a decrease in transaction costs should result in an increase in the effect of the medium-term cycles on financial flows.

financial inflows to semi-periphery countries. The most important of which, regarding this study, can be formulated as follows:

Hypothesis 2.1 (H2.1)**.** *The influence of the CLIF cycles on financial inflows to the semi-periphery is dominated by a countercyclical substitution effect.*

Based on A2.3, this hypothesis suggests that the substitution effect is countercyclical *and* has a greater impact than the volume effect. This first part indicates that changes in investment shares by investors resulting from the CLIF cycles have a countercyclical impact on financial inflows. This implies that countercyclical components of the substitution effect (e.g., rising investment in the semi-periphery during the downward phases of the medium-term cycles in the center because investment opportunities become relatively more profitable in the semi-periphery during this period) outweigh other potential procyclical components (e.g., negative impact on expected returns in some countries because of a drop in the exports in price or in volume during the downward phases of the CLIF cycles). The second part informs us that the substitution effect is not countercyclical but also that it overshadows the volume effect (i.e., the procyclical increase in financial investment to the semi-periphery throughout the CLIF cycles caused by the procyclical rise in the amount of investable financial funds).

2.2.3 Data and Indicators

This section introduces the indicators and data used to build estimates of the CLIF cycles, financial flows, and control variables (regressors). An overview of the main data used in this chapter is provided by Table 2.1.[28]

Estimates for CLIF cycles

As defined in Chapter 3, the CLIF cycles are the weighted mean of the financial and industrial cycles.[29] To construct the estimates for the financial and industrial cycles, I ex-

[28]Details on the classification of countries can be found in Section 1.2.3 and Appendix B.1.

[29]Because of data limitations, estimations for these cycles are only used to characterize center leader economies, namely the US, Japan, France, the UK and Germany.

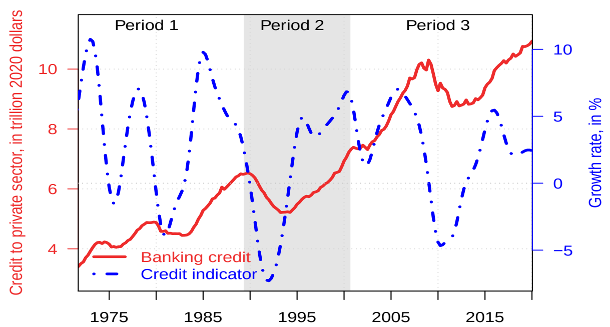

Figure 2-2: Credit to private sector in the US

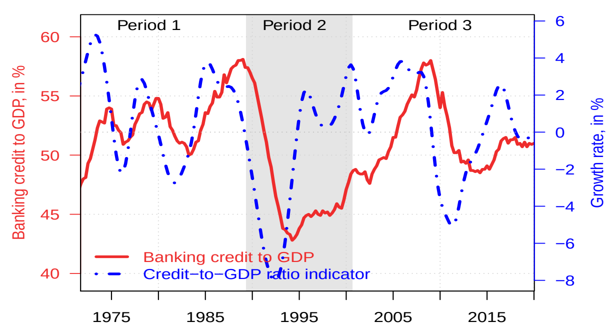

Figure 2-3: Credit-to-GDP ratio in the US

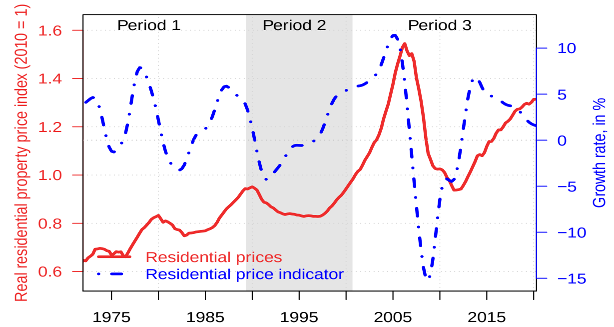

Figure 2-4: Residential price in the US

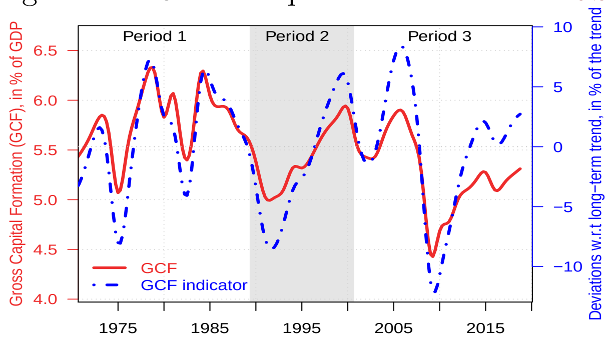

Figure 2-5: GCF in the US

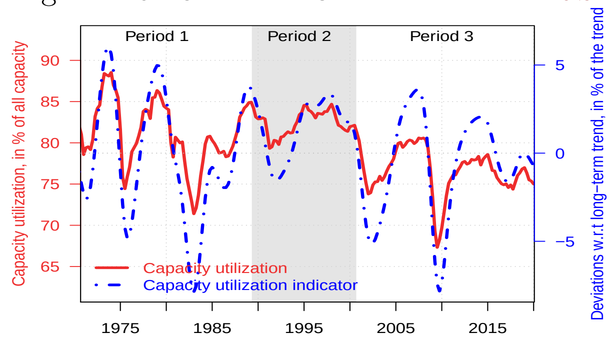

Figure 2-6: Capacity utilization in the US

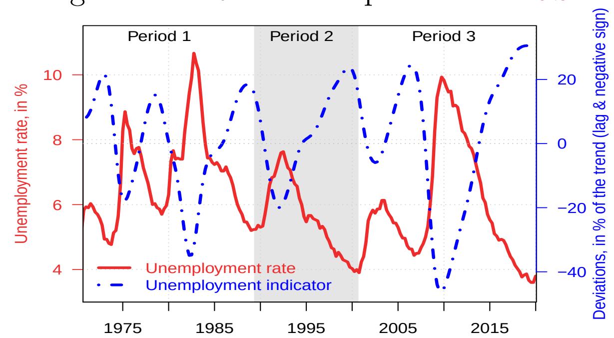

Figure 2-7: Unemployment rate in the US

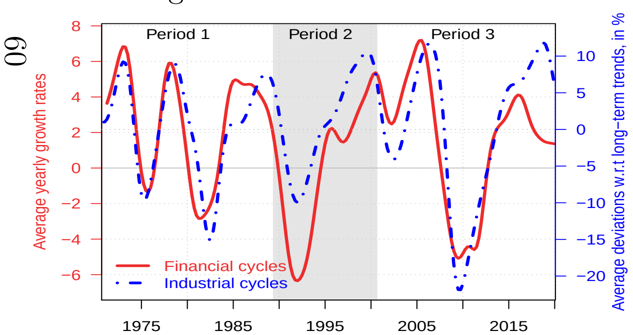

Figure 2-8: Cycles in the US

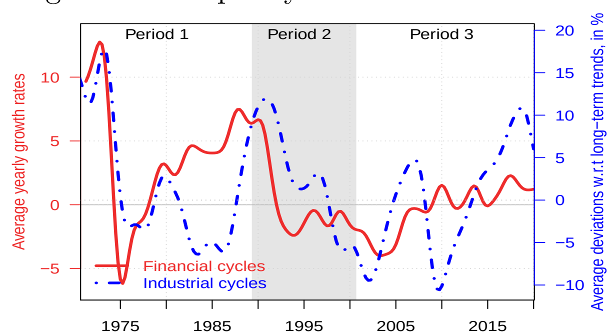

Figure 2-9: Cycles in Japan

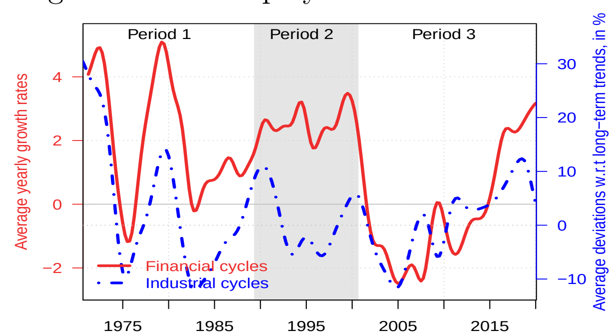

Figure 2-10: Cycles in Germany

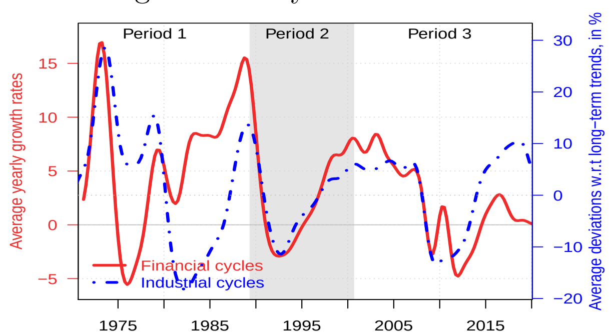

Figure 2-11: Cycles in the UK

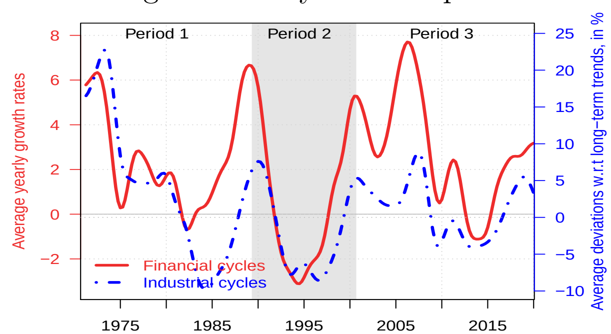

Figure 2-12: Cycles in France

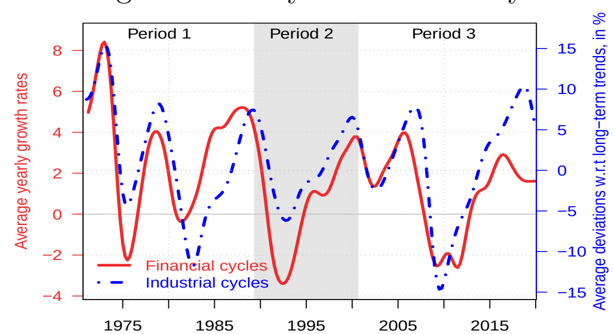

Figure 2-13: Cycles in center leader countries

ploited data provided by the Bank for International Settlements (BIS), the Organization for Economic Co-operation and Development (OECD), the World Bank, the Federal Reserve Economic Data (FRED), and the Ministry of Economy Trade & Industry (METI). Following the methodology developed in Borio (2014), financial cycles are estimated by the medium-term average real – i.e., deflated by consumer price index (CPI) – growth of (i) private banking credit to non-financial sector, (ii) private banking credit-to-GDP ratio, and (iii) residential property prices. Figures 2-2, 2-3 and 2-4 respectively exhibit the variables in 2020 US dollars and the medium-term growth rates used to build the financial cycles for the US.[30] We observe some periods of important increases in residential prices and in the amount of credit in the US, as well as some periods of large contractions. We also notice that medium-term fluctuations between these macroeconomic variables bear strong concordances.[31] We rely on a similar methodology to create estimates of industrial cycles. They are the average measure of the medium-term deviations (relative to and in percentage of the long-term trends) between (i) GCF (in percentage of GDP), (ii) capacity utilization (in percent of the total production capacity), and (iii) unemployment rate (in percentage of the labor force).[32] Figures 2-5, 2-6 and 2-7 respectively exhibit the variables in 2020 US dollars and the medium-term deviations used to build the industrial cycles for the US. Likewise, we observe large concordances between these three macroeconomic indicators.

The financial and industrial cycles are the mean between their three respective subcomponents. The financial and industrial cycles for the US, Japan, Germany, the UK and France are respectively exhibited in Figure 2-8, 2-9, 2-10, 2-11 and 2-12. Correlations between the financial and industrial cycles for the five center leader countries are high, indicating a sizable concordance between the financial and industrial macroeconomic

[30] Similar charts can be found in Appendix A.2.2 for Japan, the UK, Germany and France. This also concerns variables used to build the estimates of industrial cycles.

[31] The methodology used here is developed in Drehmann et al. (2012) and Borio (2014) where equity prices and aggregate asset prices are not included because they do not fit the medium-term perspective well given their large short-term components.

[32] Although the employment rate is more in line with the other two indicators and the development of productive capacity in the industrial sector than the unemployment rate, I use the latter because of its greater availability of data (notably for Japan and Germany).

characterizations (particularly for the US).[33] These high levels of correlation confirm the relevance of jointly analyzing the two medium-term cycles as well as the need to differentiate these two effects.[34]

To construct univariate indicators for each medium-term cycle in center leader countries, the financial cycles (resp. industrial cycles) are estimated by computing the weighted average of the financial (resp. industrial) cycles of the center leader countries. The weights correspond to the average values of the current GDP for each country for the whole period (1971-2019).[35] Figure 2-13 displays the financial and industrial cycles obtained via this method.[36] A high degree of concordance is noted; periods of industrial overcapacity match, to a significant extent, periods of medium-term financial distress. The CLIF cycles are built by taking the means of the standardized values of the financial and industrial cycles of the center leader countries to avoid giving different weight to financial and industrial dynamics. The univariate indicator is represented in Figure 2-1. The estimate signals five large drops in the activities of the center leader countries' financial and industrial sectors. The first two decreases appear during the first period and reveal the impact (among other factors) of the 1973 first oil shock and the 1979 Volcker monetary shock. The third period of overcapacity and financial distress in center leader countries happened at the beginning of the 1990s, marked by the burst of the Japanese bubble and recessions in the US and Europe. The fourth drop is much smaller and partially derived from the dot-com bubble at the beginning of the 2000s. The 2007-09 GFC is the global phenomenon at the root of the last large plunge exhibited by the indicator.

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[33] More specifically, the Pearson's correlations between these two cycles for the period 1971-2019 for the US, Japan, the UK, France and Germany are respectively 0.79, 0.44, 0.39, 0.66 and 0.61. The largest p-value of the associated correlation tests is lower than 10^{-4} for every country. The aggregate financial and industrial cycles of the center leader economies are also highly correlated (correlation of 0.73).

[34] Indeed, previous empirical studies might have led to erroneous conclusions by missing this fact. For example, a statistically significant effect in an empirical estimation only including financial cycles could be in fact caused by industrial effects. It is also important to acknowledge that this study mostly relies on data from Japan and the UK to disentangle these two effects, given that these two countries' medium-term cycles are the least synchronized.

[35] The US' industrial and financial cycles have the same weight in the aggregate indicators respectively. Both these weights are larger than those associated with the financial and industrial cycles of other center leader countries due to differences in terms of GDP among the countries.

[36] Similar charts for other center leader countries are exhibited in Appendix A.2.2.

Indicators	Data	Sources and links
Center-periphery axis	Current GDP per capita	See GDP and population
	Natural rent indicator	World Bank [link]
	% of the population under 14, % of urban population	World Bank [link], UN Population Division Data [link]
	Education index	Prados de la Escosura (2015)
Leader-follower axis	PPP and current GDP	World Bank [link], Maddison Project Database 2020 [link]
	Total and urban population	World Bank [link], UN Population Division Data [link]
	Global Fortune 500 index	Fortune website/magazines [link]
Financial Cycles[a]	Credit to private non-financial sector (market values), credit-to-GDP ratio	BIS data [link]
	Real residential prices	BIS data [link]
Industrial Cycles[a]	Gross capital formation	World Bank [link]
	Capacity utilization (in %)	FRED [link], OECD [link], METI [link]
	unemployment rate	FRED [link], OECD [link]
Financial Flows	Financial account, portfolio investments, FDI, other investments	IMF data [link]
Demographic regressors	Population, % of the population under 14, under-five mortality, life expectancy, fertility rate, adolescent fertility rate, dependency ratio, % of urban population	World Bank [link], UN Population Division Data [link], Penn World Table [link]
Economic regressors[b] (extended)[c]	Natural rent index, real GDP per capital, % of agriculture in GDP, human capital and education index. Extended also includes: Gross capital formation, % of gross capital formation in GDP, % of industry in GDP, % of the manufacturing sector in GDP, electricity consumption per capita, real GDP, GDP in PPP)	World Bank [link], Penn World Table [link], Barro-Lee Dataset [link], Our World in Data [link], Prados de la Escosura (2015), Historical National Accounts [link], OECD [link], EUK-LEMS Database [link], 10 sector database [link], Economic Transformation Database [link], World Input–Output Database [link]
Transmission channel matrices (TCMs)[d]	International trade (W^{trade})	UN Comtrade database [link]
	Geographic distances between capitals (W^{geo})	World Cities Database [link]
	Disbursements on external debt, PPG (W^{fin}) and % of external long-term PPG debt in US dollars (W^{cur})	World Bank IDS database [link]

Note: except for ratios or explicitly mentioned, indicators are in real terms and were adjusted for inflation if required by using a global CPI from the World Bank [link] or an alternative price index contained in the databases when available.

[a] Medium-term cycles are smoothed combination of these data.

[b] Economic regressors were smoothed using Nadarya-Watson estimations to avoid endogeneity biases.

[c] The "extended" economic regressors are not systematically used in the results for three reasons; (i) they are likely to be affected by the CLIF cycles so that the risk of creating a endogeneity bias is larger than with other variables, (ii) the quality of data is not as good as for other regressors, in particular for periphery countries, (iii) they can lead to large multicollinearity between the regressors when the number of countries is not sufficiently large.

[d] This part of the table refers to the transmission channel matrices discussed in Sections 2.3 and 2.4. With the exception of the geographic distances, the transmission channel matrices (TCMs) were smoothed so that the matrices reflect long-term economic connections between countries and avoid endogenous biases that can emerge if the CLIF cycles affect the TCMs in the short to medium-terms.

Table 2.1: Main data, their uses and references used for baseline scenarios

Financial flows

To implement the empirical identification and statistically test the core hypotheses introduced in Section 2.2.2, I use the IMF's Balance of Payments and International Investment Position dataset to estimate the financial inflows to semi-periphery countries. Four key measures are exploited. The first indicator corresponds to the sum of all net financial flows recorded in the financial accounts in the semi-periphery. Second, net portfolio investments towards the semi-periphery are viewed as a direct estimator. A third estimate is built, named *short-term investments*, which consists of the sum of net portfolio investments, net "other investments" (including debt instruments), and net financial derivatives (other than reserves) and employee stock options.[37] FDI flows, despite being regarded as significantly affected by longer-term industrial integration, are considered as the fourth measure of financial flows. The most important indicator, for this study, is the approximate for the short-term investments which includes the major part of the financial flows matching the views expressed in Section 2.2.1.

The use of these indicators relies on the assumption of the correct accounting and registration of financial flows among semi-periphery countries during the period. This implies that errors and omissions in balance of payment data and the impacts of tax havens are not sufficiently strong enough to alter the patterns in the indicators.[38] Moreover, the assumption supposes that financial accounts adequately record the investment flows to the semi-periphery. This means that current accounts are assumed to properly measure the trade balance, net primary income, and net unilateral transfers (considered too small to play a major role). In other words, I assume that net current account flows do not incorporate major net investments from the center to the semi-periphery (for instance,

[37]Other investments are particularly important for the first period (see Figure 3-5 and discussions in Section 3.3.1). Notably, they allow the inclusion of large bank loans. Derivative investments are less important and the results are not significantly affected by the inclusion or exclusion of this category of financial product. The baseline results do not incorporate them in the category "short-term investments."

[38]For example, an underlying hypothesis is the absence of a procyclical or countercyclical pattern in the use by center economies of semi-periphery countries as offshore intermediate vehicles for their investment strategies in a third destination with one of the two flows not properly recorded. This could artificially increase or decrease the statistical relationships between the indicators, but not change the overall pattern.

through transfer pricing techniques), or at least that these transfers through current account transactions either are weakly impacted by the CLIF cycles or have a common pattern with the four indicators used so that they do not distort the relationship between the CLIF cycles and these indicators of financial flows.

Independent variables

To control the effects of domestic factors, all the baseline estimations include country fixed effects. Moreover, three groups of independent (or control) variables were included in most simulations. The first category contains demographic data provided by the World Bank database, UN Population Division database and Penn World Table. They contain information about the total population, percentage of the population under 14 years old, under-five mortality (deaths under age 5 per 1,000 live births), life expectancy at birth (both sexes combined, in years), fertility and adolescent fertility rate (births per 1,000 women ages 15-19), the annual old-age dependency ratio [65+ / 20-64] in %, and percentage of the urban population. These variables enable the model to control for several elements associated with the stage of development as well as the size of the economy (population). The second and third categories include economic variables from the World Bank database, Penn World Table, Barro-Lee Dataset, Our World in Data website, Historical National Accounts, OECD database, EUKLEMS Database, 10 sector database, Economic Transformation Database, and World Input–Output Database. The difference between these two groups relies on their economic nature as well as the quality and availability of data. The second category (economic regressors) contains data that is available for a larger number of semi-periphery countries, of better overall quality, and less likely to be directly affected by the CLIF cycles. This data includes a natural rent index, an estimate of the real GDP per capital, value added of agriculture, hunting, forestry and fishing in the GDP (in %), a human capital and education index. The third category (extended economic regressors) contains estimates of the gross capital formation, percentage of gross capital formation in GDP, value added of industry in GDP (in %), value added of the manufacturing sector in GDP (in %), electricity consumption per capita, real GDP, GDP in PPP.

To avoid the presence of an endogeneity bias, I used the Nadaraya-Watson estimator to smooth the independent variables that could procyclical or countercyclical evolve with the CLIF cycles. Therefore, these variables capture the long-term economic stage of development of the semi-periphery countries, and not cyclical or shorter-term fluctuations. For the baseline estimations of this study, the smoothed variables are all economic variables (except the human capital index, already very smooth) and the percentage of urban population. Importantly, raw data for these economic variables include several missing data for the sample of semi-periphery countries (and even more for periphery countries). To alleviate the problem of missing data and avoid introducing a sample bias by excluding countries, I implemented a multiple imputation technique exploiting recent discovery in the imputation literature, several proxy indicators (e.g., electricity production), and combining various estimates by different databases (e.g., several estimates of the real GDP).[39]

2.2.4 Empirical results

Hypothesis 2.1 argues that financial and industrial medium-term cycles in center economies, the CLIF cycles, trigger a pattern of countercyclical international financial flows to semi-periphery countries. In the introduction, Figure 2-1 exhibits the indicators of CLIF cycles and financial account flows. The negative correlation (-0.47) between the two estimates supports the hypothesis. Investments surged to semi-periphery countries before a drop in CLIF cycles at the beginning of the 1980s, subsequently triggering financial outflows. The same pattern happened during the 1990s and between 2008-14. We see that each subperiod (periods 1, 2, and 3 on the chart) is characterized by massive financial inflows followed by an abrupt drop. These three periods of abrupt rises and then

[39]This method is based on the argument that "multiple imputation has been shown to reduce bias and increase efficiency compared to listwise deletion. Furthermore, ad-hoc methods of imputation, such as mean imputation, can lead to serious biases in variances and covariances" (Honaker et al., 2011).

plunges in financial flows towards the semi-periphery correspond to the three waves of financial crises that affected semi-periphery countries, such as explored in Chapter 3.[40]

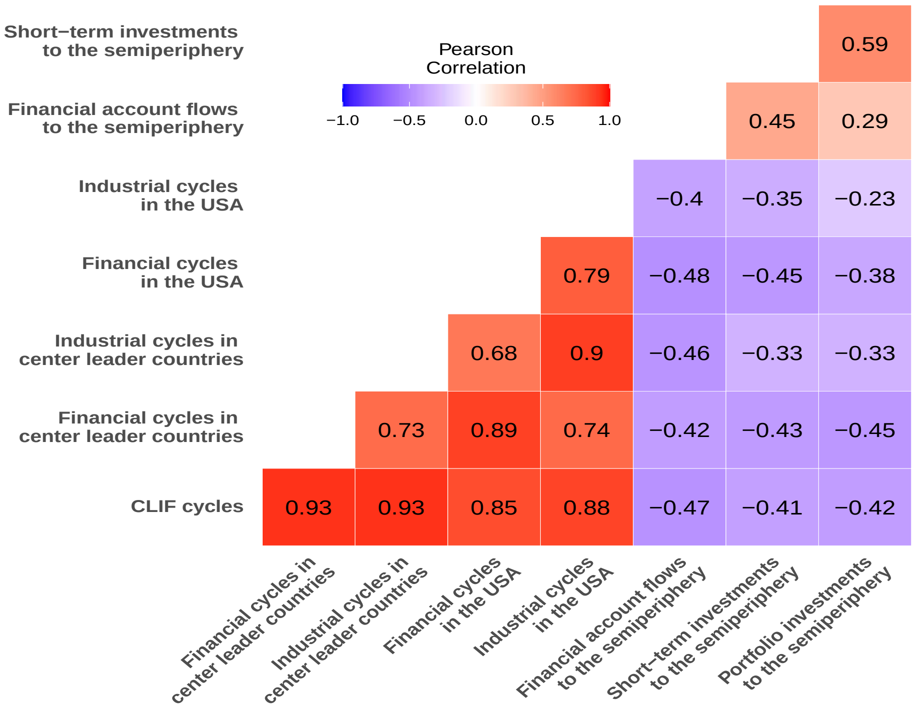


Figure 2-14: Correlations and countercyclicity between financial flows and CLIF cycles.

The figure exhibits the Pearson's correlations between different key aggregates of financial inflows of the semi-periphery and the medium-term financial and industrial cycles for the US and center leader countries. The procyclicity between medium-term cycles in the center and their respective countercyclicity with the financial flows to the semi-periphery are highlighted by colors associated with correlation levels (blue for negative values and red for positive values).

A broader assessment of Hypothesis 2.1 is provided by Figure 2-14 displaying the Pearson's correlations between different key estimates. We first note that major components of the CLIF cycles (industrial and financial in center leader countries or in the US) are highly correlated to each other. We also observe significant correlations between the three indicators of financial flows towards the semi-periphery. More importantly, large and significant negative correlations are measured between the estimates of financial flows and those of medium-term cycles.[41] The highest p-value associated with all these correlations

[40]Note that the views expressed at the aggregate level rely on the additional assumption that cross-country investments inside the semi-periphery cancel each other out such that the aggregate indicators measure estimate of the financial flows to the semi-periphery from the rest of the world.

[41]Two major exceptions exist and are worth mentioning. The results suggest that the financial cycles

is below 0.2 %.[42] Finally, we observe that financial cycles (in the US or for center leader countries) have on average a slightly more negative correlation with financial flows, and in particular for portfolio investments.

While aggregate results provide evidence confirming Hypothesis 2.1, more granular estimates based on the empirical identification are required. The main estimates of the parameters for DGP 1 are exhibited in Table 2.2. The first and third columns provide the estimates for β^A, while the second and fourth columns decompose the CLIF cycles into its industrial and financial components. The third and fourth columns display estimates with the global factor weighted by the GDPs of the semi-periphery countries. As a visual illustration, the first column corresponds to a simulation schematized by the left-hand side of Figure 2-15 when the influence of the global factor, A_t, is similar for every semi-periphery country. By contrast, the third column weights the influence of the global factor by the GDP of the affected semi-periphery country (e.g., different thickness in the connections in Figure 2-15) to incorporate that, everything being equal, a large economy should receive more financial inflows and that the effect of the CLIF cycles should then be proportional to the size of the economy.[43]

The results in columns 1 and 3 support Hypothesis 2.1.[44] Indeed, in both cases, the estimates are negative and the coefficients are significant (with p-values around 2 %). The decomposition in columns 2 and 4 between the financial and industrial cycles informs us that these components involve two different influences. As expected, the financial cycles trigger large countercyclical inflows to semi-periphery countries, with a dynamic dominated by a substitution effect. As explained in Section 2.2.1, this can be understood

between France and Germany are not procyclical and that the financial cycles in Germany and Japan are not countercyclical with financial flows to the semi-periphery. However, this does not change the overall theoretical and empirical conclusions. See details in Appendix A.2.3.

[42] If we include Spearman's and Kendall's ranking correlation tests, the highest p-value is 1.23 % for the Kendall's correlation between the industrial cycles in the US and portfolio investments towards the semi-periphery. Estimations are provided in Appendix A.2.4.

[43] These simulations include all the control variables as well as a country fixed effect. No time fixed effect was introduced as the aim of the analysis here consists to assess the existence of a countercyclical global influence. A time fixed effect would then have cancel the effect (completely for columns 1 and 2, partially for columns 3 and 4).

[44] Importantly, these results are in line with those obtained based on more sophisticated DGPs (see Section 2.3).

	CLIF cycles		GDP-weighted CLIF cycles	
A_t	-83.4**		-72.4**	
	(0.024)		(0.012)	
A_t^{fin}		-274**		-212***
		(0.013)		(2.2e-05)
A_t^{ind}		155**		121***
		(0.016)		(3.7e-05)
CFE	Yes	Yes	Yes	Yes
TFE	No	No	No	No
Regressors	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.068	0.085	0.085	0.14
Log-likelihood	-57019	-56957	-56958	-56730
N	6838	6838	6838	6838

Table 2.2: Estimates of DGP 1 for semi-periphery countries with short-term flows.

A_t refers to the CLIF cycles and A^{fin} (respectively A_t^{ind}) represents an average of the medium-term financial (resp. industrial) cycles of the center leader countries. Financial flows considered here are portfolio investments and other investments in the balance of payments (to incorporate bank loans). GDP-weighted CLIF cycles indicates that the medium-term cycles on these columns are multiply by the real GDP of the economies that they are impacting, to capture of the size of these economies. CFE and TFE respectively stands for country and time fixed effects. DeEcEx indicates that demographic and extended economic regressors are used as control variables.
The main observation from this table is that the medium-term cycles, driven by the financial components, are negatively correlated to financial inflows in semi-periphery countries. The industrial cycles tend to produce procyclical inflows. Yet the magnitude of this effect is not as large as the countercyclicity from the financial cycles.

as a medium-term reallocation of funds by investors which are relatively more attracted by investing in semi-periphery countries when the overall expected returns in the center leader countries are lower (that is, during the downward phases of the financial cycles). In contrast, the industrial cycles promote procyclical inflows to semi-periphery countries. A reason for this effect can be that semi-periphery exports are hit relatively harder by drops in industrial than financial cycles, deteriorating their balance-of-payment situation and overall attractiveness for investors. Another explanation is that investors in the center are more prone to finance efficiency-searching investments, to finance new projects, and diversify part of their portfolio in the semi-periphery economies during the upward phases of the industrial cycles, when unemployment in the center is lower, wages are relatively higher, and facilities are running at full capacity. It is also possible that industrial cycles are more correlated to the volume effect, leading to a procyclical effect. Since the counter-cyclical effect of the financial cycles is larger than the procyclical effect of the industrial cycles, and because of their important synchronicity, the overall influence of the global factor measured by A_t is then to induce countercyclical financial inflows to semi-periphery countries.[45]

It is commonly argued that negative shocks on center countries have had important negative effects on net financial flows to semi-periphery countries because international investors repatriate their funds from the semi-periphery in reaction to these shocks. For example, Shim and Shin (2021) state that financial stress in lender countries (mostly center economies) is a "more important driver than the local financial conditions and macroeconomic fundamentals" of semi-periphery countries to explain banking outflows as international banks decrease their lending. My findings support that, in fact, on average more funds are invested in the semi-periphery during the downward phases of the CLIF cycles. Two explanations are worth mentioning in regard to this apparent paradox. First, an explanation might be that local investors play a stabilizing role, offsetting the retrenchment of foreign investors. This is highlighted in Adler et al. (2016) for global risk aversion shocks.[46] Second, the difference could stem from two different temporal interpretations. While indicators of global factors – including my estimates of the CLIF cycles – are usually strongly correlated with indicators of global risk aversion, the defining in empirical studies of "shocks" tend to overweight short-term fluctuations (e.g., with corporate bond spread). My approach focuses on medium-term components. It is therefore possible that two effects affect the net financial flows in opposite directions over different time-spans.

2.2.5 Robustness analysis

Several robustness checks were performed. Different normalizations were tested for each subcomponent of the industrial and financial cycles. I assessed the impact of standardizing (minus the mean and divided by the standard deviation) each subcomponent,

[45] Although not as significant, estimates for the influence of the industrial cycles alone indicate a countercyclical effect (a negative coefficient). It is only when estimate with the financial cycles – i.e., when we measure the marginal influence of the industrial cycles – that a procyclical is observed. Additionally, estimates in columns 3 and 4 are very robust to the inclusion of a time fixed effect.

[46] Yet, the study do not provide such evidence in the case of global monetary policy shocks.

dividing the indicator by their respective long-term trends, or keeping the growth rate. Each configuration provides similar results. Different smoothing techniques were tested: simple moving average, bandpass filter (for example, based on the Fourier decomposition), Nadarya-Watson estimates, cubic spline estimation, Hodrick–Prescott filter, and Kalman filter. The results are robust to changes in the smoothing (between different techniques, and within techniques with different metaparameters). Similar patterns and correlations are observed by only using subsets of the indicators used to build financial and industrial cycles (for example, by only using GCF and capital utilization, without unemployment rate, for the industrial cycles). The substitution of several variables by close but different estimates were also evaluated.[47] The statistical results are marginally affected by these specification changes. Different weights between industrial and financial cycles as well as between countries to build the indicator of the CLIF cycles were tested (current GDP, GDP in PPP, total amount of credit in the economy, etc.). The results are robust to these changes. Similar variations (smoothing techniques, composition, etc.) for control variables were also tested. The results introduced in the above sections are robust to all of the changes. Various changes in the classification of countries (center leader and semi-periphery countries) do not modify the main conclusions. Variation in metaparameters and variables used for the clustering (classification) lead to similar conclusions, The inclusion of Canada and/or Italy in the set of center leader countries does not alter the overall results and the countercyclical hypothesis is robust to this alternative specification. Different sets of countries were tested for the semi-periphery as well. For example, for the aggregate results, a time-varying sample (a different set of countries for each of the three periods) were tested and no major change was observed. The impact of a potential sample bias was assessed (for example, by including only countries for which we have data since 1977), and our results are also resilient in this sense.[48] In all cases, we observed a high level of procyclicity between medium-term cycles of center leader coun-

[47]For example, this includes the use of gross fixed capital formation as a substitute for GCF, total private credit as a substitute for total banking private credit, etc. These variables are usually highly correlated. The baseline variables were chosen because more data were available

[48]Details of the sample bias for the aggregate results can be found in Appendix A.3.

tries and a high level of countercyclicity between these medium-term cycles and financial flows to the semi-periphery. I tested Hypothesis 2.1 for enlarged or restricted samples for the semi-periphery and periphery. The conclusions remained the same. Finally, diverse specifications were examined. I tested the model with and without country fixed effects, different compositions, interactions and normalization for the dependent variables. Because of a small serial (cross-sectional) correlation, I tested the model with various lags. Likewise, to verify the influence of Assumption 2.4, I tested several specifications with higher order terms. In all cases, the reported conclusions are robust and consistent.[49]

2.3 Multipolar model and transmission channels

This section complements the previous one by exploring the transmission channels through which the CLIF cycles influence the short-term financial flows to semi-periphery countries. I start by developing a generalized version of the two-country model in Section 2.3.1. Then, Sections 2.3.2 and 2.3.3 introduce the additional methodological aspects and data specific to cover the empirical test. Section 2.3.4 discusses the empirical findings.

2.3.1 Multipolar model

Rather than considering the center and semi-periphery as homogeneous blocks, I consider here a model with N_c center and N_s semi-periphery economies, with $N = N_c + N_s$. For simplicity, I assume no impact of the amount invested on the returns in semi-periphery countries ($\eta_i = 0$). Since several center countries are now included in the model, an equivalent number of components of the CLIF cycles are modeled, noted A_{mt} for the center country m. To capture additional network effects, I associate two proximity weights to each pair investor-country which model a certain level of economic ease and confidence in the investor i with regard to their investments in the country n and are noted u_{nit} and v_{nit}. The weight u_{nit} is viewed as a multiplicative factor of the expected returns.

[49] A few additional tables of results are provided in Appendix A.3. Estimations for different configurations and details on the tests are available upon specific request.

The weight v_{nit} divides the coefficient of risk to invest in the country σ_{nit}. Therefore, both are modeled such that, everything else being kept equal, an increase in one or both of them should increase the optimal investment share to the semi-periphery country n, noted θ^*_{nit}.[50]

In this multipolar model, a financial investor i has to decide the share of their investment to invest in each of the N countries to maximize their return while minimizing the risk. With $\boldsymbol{\theta}^*_{it} = \{\theta^*_{nit}\}$ and S_c (resp. S_{sp}) the set of indexes for the N_c center (resp. N_{sp} semi-periphery) economies and $S_T = \{1, 2, \ldots, N\}$, the optimization problem can be expressed as follows:

$$\boldsymbol{\theta}^*_{it} = \underset{\boldsymbol{\theta}_{it}}{\operatorname{argmax}} \underbrace{\sum_{n \in S_T} \theta_{nit} u_{nit} r_{nit}}_{\text{expected return}} - \underbrace{\frac{\lambda_i}{2} \sum_{n \in S_T} \frac{\sigma_{nit} \theta^2_{nit}}{v_{nit}}}_{\text{risk function}}, \tag{2.8}$$

with $r_{nit} = \kappa_{nit} + f(A_{nt})$ for center economies ($n \in S_c$) and $r_{nit} = \kappa_{nit} + \sum_{m \in S_{sp}} \epsilon_{nm} f(A_{mt})$ for semi-periphery economies ($n \in S_{sp}$) with the constraint that the total of shares invested in the different countries equals one, that is $\sum_{n=1}^{N} \theta_{nit} = 1$. I consider that the $v_{\cdot it}$ are normalized so that $\sum_{k=1}^{N} \frac{v_{kit}}{\sigma_{kit}} = 1$, which simplify expressions and can be viewed as a generalized version for multiple countries of the normalization for the two-country model. Assuming no binding constraint, the optimal allocation in the semi-periphery country n is given by the following equation:[51]

$$\theta^*_{nit} = \frac{v_{nit}}{\lambda_i \sigma_{nit}} \left\{ \lambda_i + u_{nit} \kappa_{nit} - \overline{\kappa}_{it} + \sum_{m \in S_c} \omega_{nimt} f(A_{mt}) \right\} \tag{2.9}$$

with $\overline{\kappa}_{it}$ the proximity-weighted mean of the independent-of-the-CLIF terms of the returns

[50] These proximity weights can be viewed as the product of several intertwined differences in the valuation of the investment location. For instance, cognitive biases can increase or decrease the attractiveness of a country for an investor regardless of the objective macroeconomic conditions. Linguistic and cultural proximities, as well as smaller differences and conflicts between the legal systems and business practices, are elements that can affect these weights. In addition, large economic and financial interconnection and integration (through exchanges, decrease in transaction cost, common technological standards, outsourcing and industrial integration, monetary cooperation, currency peg, trade and investment agreements, etc.) also alter these coefficients.

[51] See Appendix A.1.3 for the demonstration and discussion with and without binding constraints.

given by $\overline{\kappa}_{it} = \sum_{k \in S_T} \frac{v_{kit} u_{kit}}{\sigma_{kit}} \kappa_{kit}$, ω_{nimt} the impact factor of the medium-term cycles in the center country m on the investment share in the semi-periphery country n given by $\omega_{nimt} = u_{nit}\epsilon_{nm} - \overline{\epsilon}_{imt} - \frac{v_{mit} u_{mit}}{\sigma_{mit}}$.[52] In Equation 2.9, $\overline{\epsilon}_{imt}$ is the proximity-weighted mean of the direct impact of the medium-term cycles in the center country m on the semi-periphery and is expressed as follows $\overline{\epsilon}_{imt} = \sum_{k \in S_{sp}} \frac{v_{kit} u_{kit}}{\sigma_{kit}} \epsilon_{km}$. We can note that ω_{nimt} (respectively $u_{nit}\kappa_{nit} - \overline{\kappa}_{it}$) increases with ϵ_{nm} (resp. κ_{nit}). Using matrix notations, these coefficients ω_{nimt} can be viewed as components of a transmission channel matrix (TCM) between the investment shares for each semi-periphery countries, $\theta^*_{it} = (\theta^*_{1it}, \theta^*_{2it}, \ldots, \theta^*_{N_s it})'$, and the vector of the medium-term cycles in center economies, $(f(A_{1t}), f(A_{2t}), \ldots, f(A_{N_c t}))'$.

This solution can be regarded as a generalization of Equation 2.3. In line with the results for the two-country model, everything else being kept equal, the optimal share of investment in a semi-periphery country θ^*_{nit} is likely to be countercyclical with the CLIF cycles (that is, $\omega_{ni..} < 0$ if $\epsilon_{n.}$ are not too large and positive), decreases with the estimated risk in this country σ_{nit}, and increases with the average expected returns relative to the other countries ($u_{nit}\kappa_{nit} - \overline{\kappa}_{it}$). Moreover, if the investor i is very risk-averse (meaning that $\lambda_i \gg f(A_{mt})$, $u_{nit}\kappa_{nit}$, and $\overline{\kappa}_{it}$) the share of investment is $\theta^*_{nit} \approx \frac{v_{nit}}{\sigma_{nit}}$ and the driving force is the assessment of risk between the different countries (weighted by v_{nit}). As expected, a rise in one or both of the two proximity weights, v_{nit} and u_{nit}, increases the investment share θ^*_{nit}. Less predictably, these proximity weights also influence the impact of changes in the CLIF cycles. For example, a decrease in v_{nit} will also decrease $\frac{\partial \theta^*_{nit}}{\partial A_{mt}}$, $\forall\, m$.

Several heterogeneities can be identified from this solution that can lead to different sensitivity to the CLIF cycles. These differences are mostly the result of heterogeneities in the macroeconomic sensitivity of the returns (ϵ_{nm}) and the proximity weights (v_{nit} and u_{nit}) within the semi-periphery. First, macroeconomic variables of some semi-periphery (and periphery) countries can be highly procyclically sensitive to the medium-term cycles in one or several center economies (i.e., ϵ_{nm} can be very high for a few values of m) leading to a procyclical increase in θ^*_{nit} because ω_{nimt} would be positive for these center economies

[52]For center economies, Equation 2.9 holds with $\omega_{mimt} = u_{mit} - \overline{\epsilon}_{imt} - \frac{v_{mit} u_{mit}}{\sigma_{mit}}$ and $\omega_{nimt} = -\overline{\epsilon}_{imt} - \frac{v_{mit} u_{mit}}{\sigma_{mit}}$, $\forall\, n \neq m$.

and dominate the influence. However, some other semi-periphery economies can have developed more independent domestic markets so that the coefficients ϵ_{nm} are all relatively small. These economies would therefore receive a larger share of the investment during the downward phases of the CLIF cycles given that ω_{nimt} would be negative ($\forall\, i,\ m$). Likewise, if we assume that the aggregate return in a semi-periphery country n is independent of the CLIF cycles ($\epsilon_{nm} = 0,\ \forall\ m$), the share of investment to this semi-periphery country will still depend on these cycles. This is because this semi-periphery country is a substitution to (i) other semi-periphery countries whose macroeconomic returns are impacted by the CLIF cycles and (ii) center countries whose returns are directly altered by these medium-term cycles.

Second, substantial heterogeneities can be caused by large variations among the proximity weights between countries. Assuming that the proximity weights for Mexico are zero for all non-American investors (i.e., $u_{n^{MEX},i,t} = 0$ and $v_{n^{MEX},i,t} = 0\ \forall\ i \notin I_{USA}$), only American investors invest in Mexico. This indicates that these proximity weights can considerably shape the orientation of the investments. Inversely, if we assume that American investors ($i \in I_{USA}$) have a much higher and similar preferences for investing in the US or Mexico than other countries.[53] They are then only investing in these two countries. Interestingly, even in this specific context, the investment share by American investors to Mexico depends on the CLIF cycles of all center economies because these medium-term cycles impact the macroeconomic returns in Mexico through the terms ϵ_{nm}.[54] Importantly, in practical situations, the proximity weights u_{nit} and v_{nit} and the macroeconomic sensitivities ϵ_{nm} are not independent of each other and likely depend on the level and nature of the economic integration.[55]

A global and regional influence of the CLIF cycles on financial investments to semi-

[53] That is $u_{n,i^{USA},t} >> u_{p,i^{USA},t}$ and $v_{n,i^{USA},t} >> v_{p,i^{US},t}$, $\forall\, n \in \{n^{MEX}, n^{USA}\}, p \notin \{n^{MEX}, n^{USA}\}$.

[54] If I assume (for simplicity) that American investors have similar expectations and preferences and that $u_{n^{MEX},i^{USA},t} = u_{n^{USA},i^{USA},t} = u_t$ and $v_{n^{MEX},i^{USA},t} = v_{n^{USA},i^{USA},t} = v_t$, the share of investment by American investors to Mexico is given by: $\theta^*_{n^{MEX},i^{USA},t} = \frac{v_t}{\lambda\sigma_{n^{MEX},t}}\left\{\lambda + \frac{v_t u_t}{\lambda\sigma_{n^{MEX},t}}\left(\kappa_{n^{MEX},t} - \kappa_{n^{USA},t}\right) + \sum_{m\in S_c} u_t\epsilon_{n^{MEX},m}\left(1 - \frac{v_t}{\sigma_{n^{MEX},t}}\right) f(A_{mt})\right\}$.

[55] This is the reason why the empirical assessments in Section 2.3.4 rely on several economic networks.

periphery countries emerges from Equation 2.9. This can be highlighted by assuming two simplifications. In line with the linearization process performed below (Section 2.2.2), the function f can be assumed to be a linear operator such that $f(Ax+By) = Af(x)+Bf(y)$. The CLIF cycles can be decomposed into two components such that $A_{mt} = A_t + \tilde{A}_{mt}$ with A_t a global factor common to all center economies and $\tilde{A}_{mt}$ a "pure" domestic component, with $\tilde{A}_{mt} \perp\!\!\!\perp \tilde{A}_{nt}$, $\forall\ n \neq m$. As a result, the influence of the CLIF cycles A_{mt} on the investment share θ^*_{nt} is the sum of the influence of a global factor and a regional influence; with $\sum_{m\in S_c} \omega_{nimt} f(A_{mt}) = \omega^{GF} f(A_t) + \sum_{m\in S_c} \omega_{nimt} f(\tilde{A}_{mt})$, where $\omega^{GF} = \sum_{m\in S_c} \omega_{nimt}$ is the coefficient of influence for the global factor on the country n. This suggests that the global factor has a different impact on different semi-periphery countries, depending on their overall macroeconomic sensitivity to the medium-term cycles ($\sum_m \epsilon_{nm}$) and the proximity weights of the largest investors.[56] The regional influence (referring to regional integration) emerges from the observation that ω^{GF} no longer depends on ϵ_{nm} so that the domestic components $\tilde{A}_{mt}$ are the only channels through which the CLIF cycles create differentiated macroeconomic impacts due to diverse macroeconomic links with the center and semi-periphery economies, captured by ϵ_{nm}. Proximity weights play also an important role regarding regional influences.[57]

[56] For example, assuming that all major investors have similar proximity weights and expectations and that their total investment is unchanged ($q_{it} = \tilde{q}_{it}$), the differential between the impact of a change in the global factor A_t between two semi-periphery countries n_1 and n_2 is given by $\frac{\partial}{\partial A_t}\left(\theta^*_{n_1,t} - \theta^*_{n_2,t}\right) = \frac{v_{n_1,t}u_{n_1,t}}{\lambda\sigma_{n_1,t}} \sum_m \epsilon_{n_1,m} - \frac{v_{n_2,t}u_{n_2,t}}{\lambda\sigma_{n_2,t}} \sum_m \epsilon_{n_2,m}$. For similar proximity weights ($v_{n_1,t} = v_{n_2,t}$ and $u_{n_1,t} = u_{n_2,t}$) and risk valuation ($\sigma_{n_1,t} = \sigma_{n_2,t}$), if $\sum_m \epsilon_{n_1,m} > \sum_m \epsilon_{n_2,m}$, a drop in A_t would lead to a larger decrease (or lower increase) in funding to country n_1 than n_2 because of its macroeconomic sensitivity to the global factor. Likewise, for similar macroeconomic sensitivity ($\sum_m \epsilon_{n_1,m} = \sum_m \epsilon_{n_2,m}$) and risk valuation ($\sigma_{n_1,t} = \sigma_{n_2,t}$), if large investors prefer to invest in country n_1 (so that $v_{n_1,t}u_{n_1,t} > v_{n_2,t}u_{n_2,t}$), a drop in the global factor A_t would lead to a larger decrease (or lower increase) in funding to country n_1 than n_2 because of the preferences of major investors.

[57] For example, a drop in $\tilde{A}_{n^{USA},t}$ for the US will trigger more macroeconomic impact on Mexico than on European semi-periphery countries due to a higher macroeconomic proximity. This is included in the model through the coefficients ϵ_{nm} and the proximity weights. First, $\epsilon_{n^{MEX}n^{USA}} \neq 0$ while $\epsilon_{n^{MEX}n^{FRA}} \approx 0$ indicating that a more important macroeconomic influence of the US on the macroeconomic returns on Mexico. Second, if i and j refer to an American and French investor respectively. On average, we have that $u_{n^{MEX},i,t} > u_{n^{MEX},j,t}$ and $v_{n^{MEX},i,t} > v_{n^{MEX},j,t}$ so that, everything else being kept constant, a drop in $\tilde{A}_{n^{USA},t}$ leads to a larger reallocation of funds to Mexico than a drop in $\tilde{A}_{n^{FRA},t}$.

2.3.2 Methodology

A more sophisticated DGP enabling to assess additional characteristics of the influence of the CLIF cycles on international investments can be derived from the N-country model. Based on A2.3, I assume that the amount invested by the investor i behaves procyclically with the CLIF cycles to reflect the dynamics of the volume effect so that $q_{it} = \tilde{q}_{it} + \sum_{m \in S_c} g_{imt}(A_{mt})$.[58] After a linearization of the components depending on the CLIF cycles, financial investments to the semi-periphery country n in the N-country model can be expressed as follows:[59]

$$\phi_{nt} \simeq \sum_i \tilde{q}_{it}\xi_{nit} + \sum_{m \in S_c} w^*_{nmt} A_{mt} \tag{2.10}$$

with ξ_{nit} the share of investments in absence of the CLIF cycles and w^*_{nmt} the first-order weights characterizing the influence of the CLIF cycles.[60]

Importantly, because in practice the exact shape of the transmission channel matrix (TCM) – noted W^*_t and composed of the weights w^*_{nmt} – is unknown, an approach consists in estimating the transmission channels by modeling it as a linear combination of various potential known channels of transmission. This alternative matrix, noted W_t, is viewed as unknown *but* composed of different known TCMs, noted W^k_t. It is given by $W_t = \sum_{k=1}^{K} a_k W^k_t$, with $\sum_{k=1}^{K} a_k = 1$, where a_k represents the relative weight of W^k_t. Each matrix W^k_t is normalized so that $\sum_{nm} w^k_{nmt} = N_s$, $\forall\, t,\ k$ with N_s the number of semi-periphery countries.

Based on these elements, assuming that various potential transmission channels linking the semi-periphery to center countries are known, we can test the relative influence of

[58]See Sections 2.2.1 and 2.2.2 for more details. Based on Appendix A.1.2, I consider $\frac{\partial \tilde{q}_{it}}{\partial A_{mt}} = 0, \forall\, m$, $g_{imt}(0) = 0, \forall\, m$, $\frac{\partial g_{ilt}}{\partial A_{mt}} > 0, \forall\, m = l$ and $\frac{\partial g_{ilt}}{\partial A_{mt}} = 0, \forall\, m \neq l$.

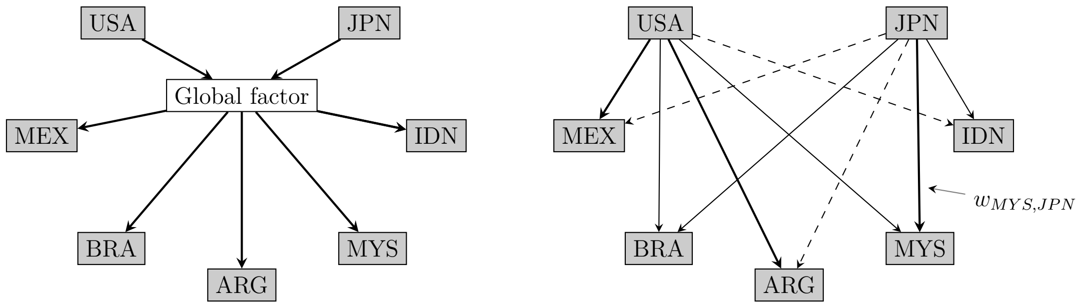
[59]For conciseness, details on the steps leading to this DGP are provided in Appendix A.1.4.

[60]Based on Equation 2.9, these factors are respectively equal to $\xi_{nit} = \frac{v_{nit}}{\lambda_i \sigma_{nit}} (\lambda_i + u_{nit}\kappa_{nit} - \overline{\kappa}_{it})$ and $w^*_{nmt} = f'_m \sum_i \frac{\tilde{q}_{it} v_{nit}}{\lambda_i \sigma_{nit}} \left(u_{nit}\epsilon_{nm} - \overline{\epsilon}_{imt} - \frac{v_{mit} u_{mit}}{\sigma_{mit}} \right) + g'_{imt} \sum_i \xi_{nit}$. The first term in right-hand side of the relation for w^*_{nmt} refers to the substitution effect highlighted in Section 2.2.1. This term is likely to be negative if the expected returns in semi-periphery country n is not too procyclically affected by the CLIF cycles (ϵ_{nm} are not too large). Likewise, the second term in this equation is positive and associated to the volume effect. The balance between the two effects determine whether the CLIF cycles have a procyclical or countercyclical influence on the financial flows.

each of these channels and whether they reflect an overall procyclical or countercyclical influence on financial investments. More specifically, we can assume the following DGP:

$$\text{DGP 2}: \qquad \phi_{nt} = \alpha_n + \tau_t + \rho \sum_{m \in S_c} w_{nmt} A_{mt} + \beta X_{nt} + \varepsilon_{nt} \tag{2.11}$$

where τ_t is the unknown time fixed effect for the period t, and A_{mt} is an estimator of the medium-term cycles in the center country m.[61] w_{nmt} is a component of W_t and weights the influence of the medium-term cycles from the center country m on the semi-periphery country n. The coefficient ρ represents the overall influence of the CLIF cycles through the different networks of interaction.[62]



Influence of the global factor A_t, measured by β^A in DGP 1

Influence of transmission channels, measured by ρ in DGP 2

Figure 2-15: Schematic of the difference between the estimations of DGPs 1 and 2.

The left-hand side of the figure represents the overall influence of the CLIF cycles such as modeled as a global factor in DGP 1. The estimate of the parameter β^A informs on this global influence. The right-hand side of the figure exhibits a similar schematic for DGP 2 where the global influence is captured by time fixed effects and the estimation aims to assess the influence through various transmission channels by estimating ρ. The thicknesses of the links indicate how large the effect is. Dashed links are even weaker.

The conceptual difference between the identification using DGPs 1 or 2 is schematized

[61] I also consider DGP 2' which consists in DGP 2 without time fixed effects but with the term $\beta^A A_t$. This model is therefore less accurate to estimate specific channels of transmission through the parameter ρ, yet it enables to have a simultaneous estimation of the effects of spatial components, ρ, as well as a global factor, β^A.

[62] This factor does not incorporate the influence of the global factor which is included in the time fixed effect. It is also worth noting that I do not impose that $a_k \in \{0, 1\}$. Then, these coefficients can be negative. In such scenario, this indicates that the effect associated with the specific TCM W_t^k is of different direction that the overall contagion effect (through W_t^k). For example, for $K = 2$, if we have $a_1 = 1.2$, $a_2 = -0.2$, and $\rho = -5$, this indicates that the overall influence is countercyclical ($\rho < 0$) and $|\rho||$ informs us of the intensity of the overall effect. The major part of the influence goes through W_t^1 ($|a_1| > |a_2|$). The CLIF cycles have (on average) a procyclical influence on countries well connected to center economies through W_t^2 because $a_2 < 0$.

in Figure 2-15. On the left-hand side, it can be seen that β^A estimates the overall intensity and nature (procyclical or countercyclical) of the influence of the CLIF cycles as modeled by a global factor, A_t. On the right-hand side of this equation, the pattern of interaction is more complex and is modeled by different one-to-one weights, w_{nmt}. A small positive value of w_{nmt} relative to w_{lmt} indicates that the influence of the center country m (e.g., Japan on the figure) is smaller on the semi-periphery country n (e.g., Argentina) compared to the semi-periphery country l (e.g., Malaysia).

To test the influence of various transmission channels, I rely on the assumptions discussed in Section 2.2.2 (A2.1 to A2.4). Yet a few additional elements must be added at this stage. A2.2, which stipulates that investors maximize their expected returns in each period independently, needs to be reinterpreted. The fact that investors are independent of one another and individually optimize their returns (e.g., they are not influenced by other investors' decisions and expectations) does not lead to major difficulties. The parameters u_{nit}, u_{nit}, u_{nit} and u_{nit} partially reflect non-explicit interdependencies between investors. Because the W_t synthesizes the interconnections between the CLIF cycles and the financial investments for all investors, this modeling choice should not impact the empirical validity of the results. The most critical point is that investors re-invest at every period, cancelling several channels of path-dependency. While the issue can be incorporated by opting for a general view of the proximity weights u_{nit} and v_{nit}, this can lead the TCM W_t (or some of its components W_t^k) to become endogenous.[63] This is one of the reasons why the TCMs must model long- to medium-term components of the relations between A_{mt} and ϕ_{nt} to limit any possible endogeneity bias (see Subsection 2.3.3).

An additional assumption must be added to apply the empirical strategy deduced from the N-country model. It refers to the TCMs which model the networks of influence

[63]For example, if an investor i lent $\bar{\phi}_{ni,t-1}$ to the country n in $t-1$ and that this investor cannot convert this investment into new investable funds in t except on very high cost C, this can be reflected by writing u_{nit} as a function of $\phi_{ni,t}$; $u_{nit}(\phi_{ni,t}) = \tilde{u}_{nit} - 1_{[\phi_{ni,t}<\bar{\phi}_{ni,t-1}]}C$. In such scenario, because w_{nmt} is a function of all u_{nit} (which are functions of $\bar{\phi}_{ni,t-1}$), they have to be regarded as potential function of the investment in $t-1$.

of the CLIF cycles in Equation 2.11:

Assumption 2.5 (A2.5)**.** *W_t is (i) exogenous, and (ii) can be approximated based on macroeconomic bilateral data.*

Indeed, W_t^k needs to be exogenous for the estimation of the parameters a_k and ρ to be correct. To avoid an endogeneity bias, I smoothed the TCMs W_t^k.[64]

Conditional to A2.1–2.5, the estimates for DGPs 1 and 2 help us to empirical confirm several hypotheses relative to the impacts of the CLIF cycles on financial inflows to semi-periphery countries. The most important of which are formulated in Hypotheses 2.1 and 2.2 and summarized in Table 2.3. This table highlights the conclusions that can be deduced from the estimates of DGPs 1 and 2. Remind that Hypothesis 2.1 (introduced in Section 2.2.2) implies that a countercyclical substitution effect dominates the influence of the CLIF cycles on short-term financial flows to the semi-periphery. In this multipolar context, we can confirm this hypothesis if β^A and ρ (for semi-periphery countries) are significantly negative for DGP 1 and for DGP 2 respectively.

ρ \ β^A	$-$	$+$	?
$-$	confirm H2.1 and H2.2	procyclical, yet countercyclical for highly connected economies, infirm H2.2	confirm H2.1 only for specific channels, confirm H2.2
$+$	countercyclical, yet procyclical for highly connected economies, infirm H2.2	infirm H2.1, but confirm H2.2	
?	confirm H2.1 only for a global factor	infirm H2.1	do not confirm or infirm H2.1 nor H2.2, but support small effects

Table 2.3: Summary of the main hypotheses and the empirical identification.

The next important testable hypothesis concerns the influence of the transmission channels, such as modeled in DGP 2. It can be formulated as follows:

[64] These matrices should approximate the "real" transmission channels to incorporate the overall influence of the CLIF cycles. Yet, if this hypothesis is invalid regarding the data used (see Section 2.3.3), the parameters a_k and ρ could be biased if the missing components are correlated to the included ones. This hypothesis is very common for econometric tests and difficult to assess.

Hypothesis 2.2 (H2.2)**.** *Semi-periphery countries are more influenced by center economies with which they have the strongest connections.*

If this hypothesis is confirmed, strongly connected semi-periphery countries (potentially through various channels) are relatively more affected by the CLIF cycles than less connected economies. An alternative scenario could emerge from the estimation. If, for instance, β^A is significantly positive for DGP 1 and ρ is significantly negative for DGP 2, this could indicate that while financial flows increase procyclically with the CLIF cycles for most semi-periphery countries, highly connected semi-periphery economies are less affected, and perhaps even experience countercyclically financial inflows.

2.3.3 Transmission channel matrix

The identification strategy relies on a network structure connecting semi-periphery and center leader countries which must be specified *a priori* to build a reasonable and exogenous TCM such that it likely respects A2.5. This network structure needs to be a bilateral peer structure with a few key features: it must approximate the long-term nature of the peer structure, evolve over time to capture the long-term evolution of the global economy, capture economic interdependencies reflecting the investors preferences and interests in investing in diverse areas, and include a set of countries, as large as possible, over a long period of time to incorporate, if not all, most of the semi-periphery countries. Two clear candidates to compute the TCM are the use of data on bilateral international trade or capital flows. In addition, I also consider geographic connections and the effect of currency composition on semi-periphery countries' external debts. The baseline estimates for the DGP 2 rely on a linear combination of these four matrices.[65]

[65] In contrast to Chapter 4, I exploit several matrices simultaneously in all the baseline scenarios for four reasons. First, more data are available to assess the connections between the center and the semi-periphery separately (e.g., this chapter) than together (e.g., next chapter) thanks to the World Bank IDS database. Secondly, the TCMs reflect the connection between the dependent (the financial flows) and independent (the medium-term cycles) variables in this study while connecting the dependent variables (the policy interest rates) in Chapter 4. Third, more data are available to estimate financial inflows to semi-periphery countries than the monetary policy interest rates so that the estimation procedure is more capable to identify the separate effects of different matrices in this study. Four, the empirical estimations of this chapter relies on a static rather than a time-varying framework.

To build a TCM reflecting financial connections between semi-periphery and center leader countries, noted W_t^{fin}, I used data from the World Bank IDS database providing annual external debt stocks and flows data. This database has the advantage of being very comprehensive and contains a large number of semi-periphery countries. As a benchmark for this study, I used the annual public and publicly guaranteed (PPG) disbursements on aggregated long-term (original or extended maturity of more than one year) total external debt by semi-periphery countries in US dollars.[66] These disbursements are the effective drawings by the borrowers (semi-periphery countries) on loan commitments during the year specified. The two major benefits of using the disbursements as well as PPG information are that data is available for almost all semi-periphery countries (all included in the IDS database) and is more reliable than other alternatives (non-PPG transfers, commitments, etc.). In this study, I also compute a trade-based TCM, noted W_t^{trade}, with data on gross bilateral international trade positions at an annual frequency obtained from the International Trade Statistics UN Comtrade dataset.[67] Several advantages arise from the use of international trade as a measure of economic proximity.[68] International trade is a widely used proxy for capturing economic integration and building interaction networks (e.g., Dées and Galesi, 2021; Gygli et al., 2019). Trade flows are stable and appropriately characterize the structural nature of the interaction network based on economic integration. Like the IDS database, the UN Comtrade dataset includes a large set of countries over a long period of time, enabling us to build of a TCM to estimate a relevant spatial coefficient ρ_t over a large sample.[69] Interestingly, external debt disbursement and international trade data are dynamic and therefore enable us to incorporate long-term changes in the global economy, which is of particular relevance given that the time span of the

[66]Public debt is an external obligation of a public debtor, including the national government, a political subdivision (or an agency of either), and autonomous public bodies. Publicly guaranteed debt is an external obligation of a private debtor that is guaranteed for repayment by a public entity.

[67]See Appendix C.2.3 for more information on the evolution of international trade flows and the TCM over the period.

[68]These arguments reflect those introduced in Section 4.2.4 where trade flows are contrast with financial flows for the identification of international monetary policy interest spillovers.

[69]Using these data to build the two most important TCM, the main limitation in terms of data availability comes from the financial flows and regressors (in particular for periphery and poor semi-periphery countries) as well as variables useful to build the medium-term cycles of center economies.

empirical analysis is around 50 years.[70]

A conventional addition to the aforementioned financial and trade TCMs is a geographic or distance-based matrix, noted W^{geo}. In this case, the coefficients do not represent economic relations but relative geographic proximities of the countries. More specifically, the coefficients are given by the inverse of the distance between the capitals of the two countries. In contrast to other TCMs considered in this study, W^{geo} is static – it does not change over time. In essence, this matrix is easier to build for every country in the sample. A last TCM is considered in the empirical identification. Noted W_t^{cur}, it consists in a measure of the currency composition of the external debts. The more the external debt is contracted in a currency, the stronger the link is between the involved semi-periphery country and the issuer of the currency. Similarly to W_t^{fin}, this matrix is made by using data from the World Bank IDS database and incorporates a large number of semi-periphery countries. Importantly, distances between countries and the percentage of external debt in a currency do not mirror the respective economic size of the semi-periphery economies involved in the estimation process. This contrasts with the international financial flows, financial drawings on external debts, and trade transactions, which are larger for larger economies. Therefore, I multiply each row of W_t^{geo} and W_t^{cur} by the real GDP of the associated semi-periphery country (normalized so that the sum of the matrix is not altered).[71] The coefficients w_{nmt} introduced in Equation 2.11 (DGP 2) reflect a linear combination of long-term (i.e., smoothed) external debt disbursement and currency composition, trade, geographic connections, with

[70] I do not use in this chapter any TCM based on aggregate financial flows because bilateral data for such transactions or connections are of relatively poorer quality in contrast to those introduced here. See Section 4.2.4 for comments.

[71] Based on a unique-scaling factor normalization (see below), the formal definition of the two TCMs used in the baseline scenarios are then given by:

$$w_{mnt}^{geo} = \frac{\text{GDP}_{nt}}{\frac{1}{\tilde{N}_s}\sum_{i=1}^{\tilde{N}_s}\text{GDP}_{it}}\left[\frac{{}^{1}/_{\text{dist}(n,m)}}{\frac{1}{\tilde{N}_s}\sum_{k=1}^{\tilde{N}_s}\sum_{l=1}^{5}{}^{1}/_{\text{dist}(k,l)}}\right] \quad \& \quad w_{mnt}^{cur} = \frac{\text{GDP}_{nt}}{\frac{1}{\tilde{N}_s}\sum_{i=1}^{\tilde{N}_s}\text{GDP}_{it}}\left[\frac{\text{share}(n,m)}{\frac{1}{\tilde{N}_s}\sum_{k=1}^{\tilde{N}_s}\sum_{l=1}^{5}\text{share}(k,l)}\right] \tag{2.12}$$

where $\text{dist}(n,m)$ is the distance between the semi-periphery country n and the center leader country m and $\text{share}(n,m)$ corresponds to the percentage of external long-term PPG debt contracted by the semi-periphery country n in the national currency of the center leader country m.

$W_t = a_1 W^{fin} + a_2 W^{trade} + a_3 W^{geo} + a_4 W^{cur}$ where the magnitude of a_i indicates the intensity of the transmission channel i, and its sign whether this influence reinforces ($a_i > 0$) or decreases ($a_i < 0$) the overall influence (determined by ρ).

To properly assess the channels of influence of the CLIF cycles on financial flows, the normalization strategy of the TCMs is key. Two common practices exist in the current spatial econometric literature to determine appropriate normalization.[72] The first considers a *row-normalized* TCM, W_t^r, such that $\sum_{l=1}^{N_c} w_{klt}^r = 1, \; \forall \; k \in \{1, \ldots, N_s\}$. In other words, the sum of row connections is equal to one at each period of time for each country. The second approach is the *unique-scaling factor normalization* strategy, which consists of dividing the unnormalized spatial weighting matrix W_t^* (defined by international trade flows) by a scale scalar.[73] I adopted a unique-scaling factor normalization rather than row normalization for three main reasons. The row normalization strategy (i) creates distortions in the "structure" (or shape) of the TCM, and (ii) these distortions are likely to be different for every time period for dynamic matrices (that is W_t^{fin}, W_t^{trade} and W_t^{cur}).[74] These distortions are particularly important as the aim of the study is to assess the global impact of the CLIF cycles on international pattern of financial flows, and specifically on the semi-periphery. A row-normalization would overweight very small economies by "forcing" the impact to be equal for every semi-periphery country, while the unique-scaling factor normalization is deduced by relative economic relations which better reflect their economic importance. In addition, I imposed that $\sum_i \sum_j w_{ijt} = N_s$ (that is a scale factor given by $s_t = {}^1\!/_{N_s} \sum_{k=1}^{N_s} \sum_{l=1}^{N_c} w_{klt}$), in order to have the property that the overall effect of the indicator of CLIF cycles, A_t, is of similar magnitude as the product with a TCM (e.g., $W_t^{trade} A_t$) when their respective coefficients are of similar magnitude.

Another challenge emerges when using time-varying economic data to model connections between countries. A potential endogeneity bias induced by changes over time in

[72]Note that the spatial econometric literature usually refers to DGPs where the dependent variables or error terms are multiplied by TCMs.

[73]The spectral radius normalization is a specific case of unique-scaling factor normalization strategies which corresponds to the larger eigenvalue (in absolute terms) of matrix W_t^*.

[74]The question of the normalization being more crucial in Chapter 4, more details on these two arguments are provided in Section 4.2.4. Kelejian and Prucha (2010) provides complementary elements.

the TCMs can deteriorate the quality of the estimation. Two main causes can generate such biases: a potential feedback loop ($\Delta\phi_t \rightarrow \Delta W_t \rightarrow \Delta\phi_{t+1}$) or potential reverse causality ($\Delta W_t \rightarrow \Delta\phi_t$). Such biases would arise if, for instance, the upward and downward phases of the CLIF cycles contemporaneously affect trade relations, external debt disbursements, or the currency composition of the external debt. Following the arguments by Wang et al. (2019), which explain how different paces mitigate the endogeneity risk caused by time-varying TCMs, the matrices used are smoothed so that they only model long-term relations, and to not incorporate medium-term fluctuations. Therefore, this suggests that A2.5 is reasonable.

2.3.4 Empirical results

The main results of the estimates for DGP 2 are provided in Table 2.4. In line with the previous paragraphs, these findings corroborate Hypothesis 2.1 as they confirm that the influence of the CLIF cycles through various transmission channels (estimated by W_t^{fin}, W_t^{trade}, W_t^{cur} and W_t^{geo}) lead to an overall countercyclical effect. The sum of each significant coefficients estimating the parameter ρ in Equation 2.11 is negative for the four columns. For a threshold of 10 % for the p-values, the sum respectively equals to -76, -91, -63, and -92 for the four columns. The results in these two tables confirm then the dominance of a substitution effect, through a global influence and through a set of weighted interactions representing economic connections.

Tables 2.2 and 2.4 support that β^A and ρ are both significant and negative. Based on Table 2.3, these results not only confirm Hypothesis 2.1 but also corroborate Hypothesis 2.2. Table 2.2 informs us that the dominant effect is a countercyclical substitution effect. Table 2.4 shows that, on average, the more connected a semi-periphery country is, the larger is this countercyclical substitution effect. More specifically, the table highlights three effects that are worth detailing. First, when the different transmission channels are assessed, the financial connections tend to promote a countercyclical effect while trade relations might compensate this trend and lead to procyclical dynamics for

	No Time Fixed Effects		With Time Fixed Effects	
$W_t^{fin}A_t$	-223***		-207***	
	(0.002)		(0.00082)	
$W_t^{trade}A_t$	147***		144***	
	(1e-08)		(3.9e-10)	
$W_t^{cur}A_t$	83.6		73.6	
	(0.17)		(0.21)	
$W_t^{geo}A_t$	-9.07		15.3	
	(0.93)		(0.87)	
$W_t^{fin}A_t^{fin}$		-340***		-337***
		(0.0031)		(0.0095)
$W_t^{fin}A_t^{ind}$		112		101
		(0.14)		(0.27)
$W_t^{trade}A_t^{fin}$		226***		245***
		(2.6e-05)		(0.00014)
$W_t^{trade}A_t^{ind}$		-50.2*		-40.7
		(0.075)		(0.22)
$W_t^{cur}A_t^{fin}$		-65		-94.1
		(0.5)		(0.26)
$W_t^{cur}A_t^{ind}$		35.5		45.6
		(0.41)		(0.26)
$W_t^{geo}A_t^{fin}$		-57.8		-42
		(0.72)		(0.79)
$W_t^{geo}A_t^{ind}$		73*		70.6
		(0.086)		(0.15)
CFE	Yes	Yes	Yes	Yes
TFE	No	No	Yes	Yes
Regressors	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.092	0.15	0.073	0.11
Log-likelihood	-39313	-39157	-39032	-38939
N	4670	4670	4670	4670

Table 2.4: Estimates of DGP 2 for the semi-periphery with short-term financial flows

A_t refers to the CLIF cycles and A^{fin} (respectively A_t^{ind}) represents an average of the medium-term financial (resp. industrial) cycles of the center leader countries. Financial flows considered here are portfolio investments and other investments in the balance of payments (to incorporate bank loans). W_t^{fin} is a TCM based on external debt disbursements. Similarly, W_t^{trade}, W_t^{cur}, and W_t^{geo} represents TCMs repectively built based on international trade flows, currency composition of external debts, and geographic locations. CFE and TFE respectively stands for country and time fixed effects. DeEcEx indicates that demographic and extended economic regressors are used as control variables.
The main observation from this table is that the medium-term cycles influence the financial inflows to semi-periphery countries through different channels. Estimates for the CLIF cycles are negatively correlated to financial inflows (particularly notably due to the effects on rows 1 and 5) supporting Hypotheses 2.1 and 2.2.

semi-periphery countries with very high level of trade openness and integration with the center economies. When the CLIF cycles are decomposed into their financial and industrial components, this outcome is confirmed. Interestingly, the results suggest that the effect is first and foremost driven by the influence of the financial cycles. Second, in line with the previous observations regarding Table 2.2, the financial cycles tend to produce countercyclical inflows to the semi-periphery while industrial cycles tend to attenuate the effect or lead to a procyclical effect on financial inflows. Yet, the coefficients for the industrial cycles are not very significant (nor as robust as those for the financial cycles).[75] Third, the two most important channels through which the medium-term cycles in center economies seem to interfere with the financial flows to semi-periphery countries are the financial and trade connections. The currency composition of the external debts does not seem to be a relevant channel. Regarding the geographical influence, the results are not conclusive.[76]

As mentioned above in Section 2.2, I tested various specifications of the model including with and without time and country fixed effects, different compositions, interactions and normalization for the dependent variables. The impact of changes in TCMs were also assessed. Different smoothing techniques, normalizations, and compositions were tested for W_t^{fin}, W_t^{trade}, W_t^{cur}, and W^{geo}. For instance, I checked the variations caused by using another definition for W_t^{fin} using other data from the World Bank IDS dataset. Although less data was available for the alternatives, the estimations lead to similar conclusions as well.

[75]Because these coefficients are not robust, it is difficult to reach further conclusions. Nevertheless, it can be pointed out that the coefficient for $W_t^{trade}A_t^{ind}$ tend to be negative, which would infirm the above explanation (in Section 2.2.4) that semi-periphery exports are hit relatively harder by drops in industrial than financial cycles, deteriorating their balance-of-payment situation and overall attractiveness for investors. At least, this effect does not seem to be large. Otherwise, the coefficient should be positive and significant, indicating that trade connected semi-periphery economies receive less funds during the downward phases of the industrial cycles of the center economies.

[76]Yet, for some specifications (see Appendix A.3 for details), the geographical proximity seem to induce a strong procyclical effect. This could be linked to a demand effect from center economies on geographically closed to semi-periphery countries.

2.4 Heterogeneities across countries, flows and periods

This section discusses three additional hypotheses regarding the impacts of the CLIF cycles on financial flows. Notably, I briefly document differences in the effects of the CLIF cycles on patterns in international financial flows for various groups of countries, periods, and types of financial flows.

2.4.1 FDIs and portfolio investments

The first testable hypothesis concerns the presence of heterogeneities regarding the influence of the CLIF cycles on various categories of financial flows.

Hypothesis 2.3 (H2.3)**.** *Hypothesis 2.1 hold for short-term financial investments (bank loans and portfolio investments) but not for FDIs.*

It is of particular interest here to distinguish shorter-term financial flows (i.e., mostly portfolio investments for the recent decades) from longer-term investments (mostly FDIs).

At an aggregate level, in contrast with other indicators, I do not obtain robust negative correlations between the CLIF cycles and *FDI investments* to semi-periphery countries, supporting Hypothesis 2.3. In addition, Table 2.5 displays estimates of the parameters for DGP 1 for portfolio investments, and FDIs. The results indicate that the CLIF cycles have a countercyclical effects on portfolio investments – similarly to the combination of portfolio and other investments used above. Importantly, this result does not hold for FDIs, which seem more modestly influenced by the medium-term cycles. As for portfolio (including or not other investments), the financial cycles seem to contribute to countercyclical FDI inflows and industrial cycles tend to lead to procyclical FDI inflows. However, in contrast to portfolio investments, the difference between the two cancels each other out so that the overall influence seems relatively tenuous on this category of investments. For all financial flows reported in the financial accounts, with significant countercyclical effects, driven by the large influence of the financial cycles.

	Portfolio investments				FDIs			
	CLIF cycles		GDP-weighted cycles		CLIF cycles		GDP-weighted cycles	
A_t	-57.2**		-60.9***		0.0625		0.806	
	(0.043)		(0.00015)		(0.99)		(0.88)	
A_t^{fin}		-117**		-93***		-27.2***		-8.92
		(0.032)		(6.6e-06)		(0.0077)		(0.16)
A_t^{ind}		42.2		21		23.9***		9.09*
		(0.11)		(0.23)		(0.00027)		(0.064)
CFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TFE	No	No	No	No	No	No	No	No
Reg.	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.035	0.04	0.067	0.082	0.068	0.071	0.068	0.07
Log-lik.	-48170	-48155	-48069	-48018	-47752	-47741	-47752	-47744
N	6069	6069	6069	6069	6757	6757	6757	6757

Table 2.5: Estimates of DGP 1 for the semi-periphery for portfolio investments and FDIs

The analysis of the influence of the medium-term cycles through various transmission channels supports the overall conclusions developed above for portfolio investments and total financial investments, and corroborates Hypotheses 2.1 and 2.2. For FDIs, it seems that trade connections do not lead to procyclical but countercyclical investments – driven by industrial cycles –, in contrast to other categories of financial flows (for example, see second row in Table 2.4).

Overall, the analysis for different categories of financial flows supports two general conclusions. First, FDIs are less influenced by the medium-term cycles. This observation corroborates Hypothesis 2.3. The most consistent effect is the countercyclical influence of the industrial cycles on highly trade connected semi-periphery countries. These economies are likely to act as export platform for center economies. During the downward phases of the industrial cycles, the demand from the center for products manufactured in these export platforms decreases and less FDIs are needed to build new facilities. Second, as a result of the first point, the general influence of the CLIF cycles on the financial accounts of semi-periphery countries is driven by its countercyclical impacts on portfolio investments.

2.4.2 Different patterns between center, semi-periphery, and periphery countries

The second major heterogeneity relates to the categories of countries. Up to this point, I only considered the effect of the CLIF cycles on semi-periphery economies. What about the periphery and other (i.e., non leader) center countries? Regarding this question, two intertwined hypotheses can be formulated. First, we can state the following statement:

Hypothesis 2.4 (H2.4)**.** *Semi-periphery economies are the main destinations for foreign investments from the center led by the substitution effect.*

This argues that center and periphery economies do not experience such periodical waves of financial inflows during the downward phases of the CLIF cycles. The second hypothesis goes further regarding the effect on periphery countries and suggests that they actually experience procyclical financial inflows.

Hypothesis 2.5 (H2.5)**.** *Financial flows to periphery economies behave procyclically.*

In Section 2.2.1, I highlighted that a potential reason could be a large procyclical macroeconomic dependence to the center (i.e., ϵ higher than 1 for the periphery) and/or a large volume effect that dominates the substitution effect for these economies. The first effect can emerge because these periphery economies rely more on exports whose prices are more volatile and sensitive to the demand of center leader economies (energy, commodities, etc.).[77] As a consequence, the downward phases of the CLIF cycles are associated to financial difficulties and lower expected returns. Therefore, investors tend to leave rather than enter these economies during such periods.

Using aggregate data, I obtain positive correlations between the CLIF cycles and financial investments to *periphery* countries, in line with Hypotheses 2.4 and 2.5. More specifically, Table 2.6 exhibits the parameters for DGP 1 (with and without time fixed effects) for all (including semi-periphery countries), center and periphery economies. The

[77] For details on the argument that commodities are characterized by higher price elasticity compared to differentiated manufactured products, see Poelhekke and van der Ploeg (2007) and Jacks et al. (2011).

	All other countries				Center				Periphery			
	No Time Fixed Effects		Time Fixed Effects		No Time Fixed Effects		Time Fixed Effects		No Time Fixed Effects		Time Fixed Effects	
	Short-term Investments = Portfolio Investments + Other Investments											
$A_t \times$GDP	-38.1**		-43.1**		-14.9		-74.8***		56.6		75.8*	
	(0.035)		(0.012)		(0.42)		(7.2e-05)		(0.14)		(0.084)	
$A_t^{fin} \times$GDP		-98.9***		-91.6***		-45.6**		-82**		-23.7		-17.2
		(0.0025)		(0.0044)		(0.022)		(0.04)		(0.76)		(0.85)
$A_t^{ind} \times$GDP		56.9***		41.3*		30.9***		0.61		79.6**		91.3**
		(0.0072)		(0.066)		(0.0095)		(0.99)		(0.034)		(0.025)
CFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TFE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Regressors	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc
R^2	0.036	0.048	0.017	0.023	0.087	0.089	0.036	0.037	0.13	0.14	0.13	0.14
Log-likelihood	-100932	-100858	-100656	-100620	-15314	-15312	-15183	-15182	-17398	-17386	-17226	-17217
N	11656	11656	11656	11656	1640	1640	1640	1640	2771	2771	2771	2771
	Portfolio Investments											
$A_t \times$GDP	-63.5***		-76.2***		-79.8***		-107***		26.1		44.8	
	(3.7e-06)		(4.4e-06)		(2.4e-05)		(6.6e-05)		(0.26)		(0.12)	
$A_t^{fin} \times$GDP		-55.3***		-57***		-53.1***		-61.6***		-25.8		-20.3
		(2.4e-05)		(5.4e-05)		(0.0028)		(0.0086)		(0.25)		(0.59)
$A_t^{ind} \times$GDP		-14.6		-27.6		-34.1**		-55.7**		50.3**		60.7**
		(0.36)		(0.15)		(0.049)		(0.027)		(0.021)		(0.012)
CFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TFE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Regressors	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc
R^2	0.023	0.024	0.02	0.02	0.074	0.074	0.061	0.061	0.029	0.044	0.046	0.055
Log-likelihood	-85085	-85081	-84948	-84947	-15243	-15243	-15136	-15136	-9782	-9769	-9690	-9682
N	9789	9789	9789	9789	1631	1631	1631	1631	1683	1683	1683	1683
	Foreign Direct Investments											
$A_t \times$GDP	0.29		4.07		9.81		45.7***		4.94		11.2	
	(0.97)		(0.65)		(0.19)		(4.3e-05)		(0.59)		(0.35)	
$A_t^{fin} \times$GDP		-9.54		-2.37		-6.77		18.3		-7.26		1.05
		(0.44)		(0.87)		(0.79)		(0.47)		(0.36)		(0.93)
$A_t^{ind} \times$GDP		9.83		6.63		18.1		32		11.5		10.4
		(0.33)		(0.5)		(0.43)		(0.33)		(0.22)		(0.38)
CFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TFE	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Regressors	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc
R^2	0.0057	0.0063	0.0059	0.006	0.016	0.016	0.025	0.025	0.11	0.11	0.11	0.11
Log-likelihood	-89926	-89922	-89841	-89841	-14483	-14483	-14398	-14398	-11828	-11823	-11715	-11714
N	11188	11188	11188	11188	1634	1634	1634	1634	2390	2390	2390	2390

Table 2.6: Main results for DGP 1 for all, center, and periphery countries for various financial flows.

I do not use the extended economic regressors for periphery countries because it produces very high level of collinearity in the data and/or because of a lack of accuracy on the data for this group of countries.

first striking observation is that the nature of the influence of the CLIF cycles on periphery economies is drastically different from on semi-periphery economies. Notably, the financial cycles do not seem to substantially influence the financial inflows and the overall effect is dominated by a procyclical influence of the industrial cycles. These results confirm Hypothesis 2.5. An interpretation is that, in contrast to semi-periphery economies, international investors do not consider periphery economies as an alternative to center economies during the downward phases of the financial cycles in center economies. Therefore, these periphery economies are procyclically affected by industrial cycles (similarly to semi-periphery countries) because of a potential large procyclical volume effect and/or a drop in their expected exports and returns. A second conclusion emerges from the table. FDI flows tend to be less affected by the CLIF cycles for all groups of countries. The coefficients are not significant nor robust in most simulations, yet it seems that FDIs to center economies are affected procyclically by the CLIF cycles. This could be due to a volume effect affecting these highly integrated and developed economies. A third noticeable result is that the use of portfolio and short-term investments (i.e., the combination of portfolio and other investments) provide very close estimates for the effects of the CLIF cycles.

A last observation must be noticed. Like for semi-periphery economies, financial flows to center economies (as well as all non center leader economies) seem to exhibit a countercyclical pattern to the CLIF cycles. Yet, three notable distinctions should be highlighted. FDIs seem to be procyclical for center economies, while no strong pattern emerges for semi-periphery economies. Industrial cycles tend to have a countercyclical influence on portfolio investments but procyclical for bank loans for center economies. For semi-periphery countries, my results support a marginal procyclical effect for both bank loans and portfolio investments. Geographic proximity seems to play a more important role for financial flows to center economies. Overall, these results do not strongly support Hypothesis 2.4 – because of the countercyclical effect on other center economies – but suggest that Hypothesis 2.5 holds.

2.4.3 Variations across periods of time

A last hypothesis relates to the evolution over time of the influence of the CLIF cycles on short-term financial flows to the semi-periphery. It can be expressed as follows:

Hypothesis 2.6 (H2.6). *The impact of the CLIF cycles on short-term financial flows to semi-periphery countries has increased since the 1970s.*

The rational behind this hypothesis is that globalization, and in particular financial globalization, has led to an important increase in capital mobility and decrease in international financial transaction costs. As a consequence, all other things being equal, the CLIF cycles should lead to larger movements in short-term financial flows over time. Based on the previous results, this hypothesis can be viewed as equivalent to the statement that financial flows to semi-periphery economies have gradually become more countercyclical.

To test this hypothesis, I conducted two tests. Firstly, I added an interaction term between the estimates for CLIF cycles and a time factor in the DGPs ($A_t \times t$). In this scenario, the results support that the medium-term cycles contribute countercyclically to changes in short-term financial flows to semi-periphery countries. The coefficients for the CLIF cycles remains of similar signs (negative for A_t and A_t^{fin} and positive for A_t^{ind}). This confirms Hypothesis 2.1, which in itself supports the view that the financial liberalization in center economies and economic integration and interconnection of their markets with semi-periphery lead to exogenous financial influence on these semi-periphery countries. However, the results also indicate a non-linear effect of the globalization process. I obtain significant and positive coefficients for $A_t \times t$ and $A_t^{fin} \times t$, and significant and negative coefficients for $A_t^{ind} \times t$, indicating that the influence of the CLIF cycles have diminished (as well as the specific influences of the financial and industrial cycles). While substantial, these estimates suggest that this evolution does not cancel the overall influence of CLIF cycles.[78]

Secondly, I estimated the DGPs for different subperiods. A few interesting points

[78]The estimates indicate a decrease of between 40-50 % over these last four decades.

emerge from an analysis where the influence of the CLIF cycles is estimated for 1974–1990, 1990–2001, and 2002–2019. Estimates for total financial inflows, short-term (portfolio and other investment) inflows, and portfolio inflows suggest that a countercyclical substitution effect was the dominant force for these three periods.[79] These observations confirm Hypothesis 2.1.[80] Crucial to confirm or infirm Hypothesis 2.6 is the observation that the countercyclical effect on portfolio flows (as well as for the combination of bank loans and portfolio flows) is larger and more significant for the second period: $\beta^A_{t_2} < \beta^A_{t_1}$ and $\beta^A_{t_2} < \beta^A_{t_3}$. In addition, we can note that the impact of CLIF cycles on portfolio investment were not significant in some specifications before 1990. This is most likely due to a lack of data and lack of portfolio transactions between the center and semi-periphery at that time.[81]

Overall, the results tend to provide some highlights about Hypothesis 2.6 but do not lead to a definitive conclusion as the evolution seem to have been nonlinear. Specifically, the observations support the hypothesis of two conflicting effects. On the one hand, the ascending magnitude and significance of β^A between the 1970s and the 1990s suggests that the surge in capital mobility and decrease in international financial transaction costs

[79] For some specifications including the TCMs, the total financial inflows are not countercyclical for the second period. This is due to large procyclical FDIs flows to this period.

[80] Although the dominant rule for every period is a countercyclicity between the financial flows and the CLIF cycles, the marginal influence of the financial and industrial components seem to be less robust. Notably, for the second period, the results support that financial cycles led to procyclical bank loans (with a very strong countercyclical effect on portfolio investments) and that the countercyclical effect of the medium-term cycles was driven by a strong countercyclical effect caused by the industrial cycles.

[81] Three observations relative to the other hypotheses are worth mentioning. First, corroborating Hypothesis 2.3, a set of results indicates that FDI flows are associated with a strong significant procyclical effect of the CLIF cycles between 1990 and 2001 (with very small and not significant effect for the first and third periods). This is confirmed in various specifications, but with very weak and mostly not significant effect through the transmission channels modeled by the TCMs. Second, the importance and sign of the estimates for the TCMs seem to vary from one period to another, in particular for geographical proximity and currency composition. The importance of geographical location tends to decrease over time, but the signs are not consistent. Trade connections lead to relatively more procyclical effects on short-term financial inflows for every period, consistent with the hypothesis of a procyclical demand-driven effect existing through this channel. Financial connections support a countercyclical dynamic for the first and third periods for portfolio and short-term inflows, reinforcing the global countercyclical effects of the CLIF cycles.[82] Third, the analysis by sub-periods indicates that the countercyclical pattern for short-term inflows to center economies discussed above is not as consistent and robust as for semi-periphery economies. Likewise, the procyclical pattern for short-term inflows to semi-periphery is neither as consistent and robust (part of the reason might be the lack of data for this group of countries). This supports Hypothesis 2.4.

during that period did increase the influence of the CLIF cycles on short-term financial flows to semi-periphery countries. On the other hand, as argued in Aizenman (2013); Ghosh et al. (2016); Conti-Brown and Lastra (2018); Tooze (2018); Cavallo et al. (2020), several semi-periphery economies have started to implement financial and monetary policies capable of alleviating the effect of foreign influence.[83] This claim is supported by the results for the interaction terms as well as by the decrease in magnitude and significance of β^A between in the 2000s.[84]

2.5 Conclusion

This study models a pattern of cyclical international financial flows. Medium-term financial and industrial cycles in center leader countries are considered the root of cyclical financial flows to semi-periphery countries. The search for short-term yields by international investors encourage them to allocate a larger share of their funds to semi-periphery economies during periods of low profitability in center countries (i.e., the downward phases of medium-term cycles). This leads to periods of large financial inflows to the semi-periphery countries.

The empirical findings confirm key hypotheses. First and foremost, the medium-term cycles in center economies tend to promote countercyclical financial inflows (in particular portfolio and bank loans) to semi-periphery countries. Second, semi-periphery countries with strong financial connections with center economies are more likely to experience

[83]These policies include countercyclical tightening capital flow management and/or macro-prudential policies aiming to curb speculative financial inflows, reserve accumulation, limit the appreciation of their currencies, and prevent excessive credit growth.

[84]Three additional factors are likely to have interacted with the influence of the CLIF cycles and specifically its evolution over time. First, the results tend to support a high degree of idiosyncrasy for each subperiod so that the changes over time of β^A might be caused by idiosyncratic effects. As illustrations, the second period was marked by the collapse of the USSR and the third period was scarred by the GFC that massively shook the global financial ecosystem. Second, the economic rise of China has probably affected the pattern of international financial flows during the third period so that the decrease in the countercyclicity might be (partially) attributable to this effect. Third, investors from the center invested more into "frontier economies" in the aftermath of the GFC. Likewise, the results for the periphery suggest that, in the third period, financial flows were less procyclical. It is therefore possible that a contributing factor to the decrease in the influence of the CLIF cycles on short-term financial flows to semi-periphery countries in recent decades is the fact that the substitution effect for the periphery has increased as these economies have become more integrated to the global economy.

larger countercyclical financial inflows. An explanation for these results is that international investors invest more in these semi-periphery economies that are perceived as financial substitution areas for their funds when the returns in center countries are not as attractive. By contrast, trade relations tend to compensate this pattern, and can lead to procyclical financial inflows to semi-periphery countries with very high levels of trade openness and integration with the center economies. Third, foreign direct investments (FDIs) are not nearly as affected by the medium-term cycles. Fourth, the countercyclical pattern between medium-term cycles in large center economies and financial inflows is particularly salient for semi-periphery countries in contrast to smaller center and periphery economies.

3 | Medium-term cycles and balance-of-payment crises

How financial and industrial cycles in center economies induce financial crises in semi-periphery countries? A historical assessment.[1]

Abstract

Based on the concepts of medium-term cycles and center-periphery, we introduce the concept of CLIF cycles. We then explain how these cycles trigger large countercyclical short-term financial flows to semi-periphery countries. The model enables us to account for two phenomena. First, a periodic pattern of financial flows (bank loans and portfolio investments) between center and semi-periphery economies induced by the CLIF cycles. Second, these cyclical reversals are shown as at the root of the BOP crises in semi-periphery countries. To illustrate the empirical relevance of the approach, we revisit major known episodes of BOP crises in semi-periphery countries since the 1970s. This review confirms the main proposition of the model as the last three major waves of BOP crises in the semi-periphery (during the 1980s, 1994-2001, and 2008-2019) are each linked with an upward and downward phase of the CLIF cycles.

Contents of the chapter

[1]This chapter is the result of a research developed in collaboration with Jean-Christophe Defraigne.

3.1 Introduction

Several suggestions have been made to explain the emergence of financial crises in semi-periphery countries.[2] Among them, we can mention the large range of mutually reinforcing domestic structural weaknesses identified by researchers.[3] In contrasts, another approach invokes a theory of "self-fulfilling" crises (e.g., Radelet et al., 1998). In line with the literature analyzing the roles of global factors in the emergence of financial crises (e.g., Forbes and Warnock, 2012, 2020; Accominotti and Eichengreen, 2016), this paper aims to question these representations by proposing an alternative interpretation of the origins of such BOP crises.

More specifically, we explain how CLIF cycles have been triggers of large international financial flows and subsequently at the root of waves of BOP crises in semi-periphery economies. Empirical results indicate that medium-term financial and industrial cycles in center countries have been countercyclical to capital inflows towards semi-periphery countries since the 1970s.[4] This observation suggests that investors of center countries change their investment allocations following the medium-term cycles in their domestic economies. Driven by the search for higher yield, they invest a larger fraction of their capital in semi-periphery countries when investment opportunities in center countries provide lower returns. This in turn induces important medium-term cyclical international financial flows which trigger BOP crises in semi-periphery countries.

[2] The paper focuses on balance-of-payment financial crises, also called sudden stops, current account or capital flow reversals.

[3] This includes limited financial development, faulty governance structures, under-regulated markets or over-regulated with bureaucratic restrictions, unreliable contract enforcement, the corruption and greed of local political elites, local political instability, conflict of interests in the financial sector, recourse to inflationary finance or continuing expansive monetary policies, extensive dollarization of domestic and external liabilities, inappropriate peg policies and "fear of floating" of the foreign exchange rate and a lack of financial depth to absorb economic shocks. Some studies have also shown evidence that an expansion of domestic and external leverage, real currency appreciation and large maturity/currency mismatches are additional underlying factors. Large trade and financial imbalances and international financial contagion have likewise been claimed as factors increasing economic instability. Among others, some details on these different arguments can be found in Aliber and Kindleberger (2017); Gourinchas and Obstfeld (2012); Cassis et al. (2016); Claessens et al. (2014); Eichengreen (2019a); Mishkin (1999); Berg (1999); Diaz-Alejandro (1985).

[4] On average, the downward phases of their CLIF cycles are linked with increasing financial flows to semi-periphery countries.

The paper is made up of two main sections. Section 3.2 develops an explanation of (i) a periodic pattern characterizing international financial flows driven by macroeconomic medium-term cycles in center countries and (ii) how this pattern is at the root of periodic waves of BOP crises in semi-periphery countries. Section 3.3 provides a historical review of the BOP crises in the semi-periphery economies since the 1970s. This highlights that the last three major waves of BOP crises in the semi-periphery (i.e., the debt crisis of the 1980s, the financial crises of 1994-2001 and 2008-2019) are each linked with an upward and downward phase of the CLIF cycles.[5] Section 3.4 sums up our findings.

3.2 Model

This section explains the origins of a periodic pattern in international financial flows and their role as trigger for BOP crises in semi-periphery countries. In this model, I rely heavily on the concepts of center and semi-periphery countries as well as the notions of CLIF cycles. These concepts are introduced in Sections 1.2.3 and 1.2.4. The notions of pull and push factors are introduced in Subsection 3.2.1. These concepts are used to explore the question of the location of the financial investments in the semi-periphery. Building on the elements, Subsection 3.2.2 presents arguments in favor of countercyclical links between the CLIF cycles and waves of inflows to semi-periphery countries. Finally, a model of induction of BOP crises in semi-periphery countries is suggested in Subsection 3.2.3.

3.2.1 "Where": pull and push factors in the semi-periphery

The choice of location for international investments in productive capacities depends on several industrial determinants and pull and push factors. In that regard, semi-periphery countries have many location-specific advantages that can attract productive investments (see Jain et al. (2016) for an overview). These industrial determinants define the long-term characteristics of host countries that can attract foreign investments and

[5] For the sake of conciseness and rigor, details on statistical evidence backing the historical perspective are developed in Chapter 2.

then are key to understanding international financial flows. Through the development of their IPNs since the 1960s, MNEs have developed massive waves of FDI that have played the driving role in the globalization of productive investments and had a major impact on international financial flows (e.g., see Aglietta, 2000; Dunning and Lundan, 2008; Hansen and Wagner, 2022). Furthermore, even if many additional financial factors can lead investors of center countries to invest in semi-periphery countries,[6] a large share of investments in the financial sector are conditional upon the existence of sufficient prior productive investments, namely sufficient infrastructures and macroeconomic characteristics. Consequently, financial investments are viewed as conditional upon industrial determinants, meaning the distinctions between center, semi-periphery, and periphery as well as between leaders and followers.[7]

Pull and push factors are the economic and political changes which respectively either forcefully attract international financial flows into the area (pull) or repel capital so that it flows out of the area (push). They are viewed as specific, disruptive, and having localized geographical and temporal origins. While most pull and push factors are created by economic trends (e.g., economic growth, a decrease in trade balance, industrialization process, etc.), their occurrence and shape are difficult to anticipate (e.g., the date and impact of political unrest, the magnitude of a disruptive change in monetary policy, etc.). We either take the perspective of a specific semi-periphery country – e.g., the adoption of pro-market economic reforms, privatizations of State-Owned Enterprises (SOEs) – or of all semi-periphery countries as a set – an abrupt change in international commodity prices – to define domestic and international factors.

For the sake of simplicity, we focus on a subset of major pull and push factors, assuming that they are the most crucial. This subset is provided in the following hypothesis which

[6] We can mention two examples. Diversification plans of banks in center countries in Europe were born from the need for higher returns in traditional banking activities in the period of low growth in the area in 1990s. Large interest rate differentials can also be a reason for the attractiveness of some semi-periphery countries. This leads to carry trade strategies after the Japanese bubble burst in 1990s or after the GFC.

[7] For the sake of simplicity, in Section 3.2, we assume that the bulk of these industrial determinants are modeled by the position of a country inside the center-periphery and leader-follower categories.

underpins the standpoint (e.g., see Jain et al., 2016; BIS, 2021).

Hypothesis 3.1. *The pull and push factors of largest importance for the geographical distribution of international investment are (i) domestic institutional changes made to attract FDI; (ii) privatizations of SOEs; (iii) social unrest and political instability; (v) changes in commodity prices; and (vi) the contagion effect.*

Because of these pull factors, financial flows are heterogeneous among semi-periphery countries so that some economies attract a disproportionate share of capital inflows while other semi-periphery countries crave financial funds.

3.2.2 "When": Substitution effect and countercyclicity

Based on two additional hypotheses, we introduce the concepts of volume and substitution effects and show that the latter is the driving force of the countercyclical pattern between the medium-term cycles in center economies and the financial flows to semi-periphery countries.[8] The framework introduced in Section 1.2.3 relies on the following underlying hypothesis:

Hypothesis 3.2. *Investments between center and semi-periphery economies are the major components of international financial flows.*

This also includes flows from a center (semi-periphery) country to another country of the center (semi-periphery). More crucial, financial interdependencies between the center and the semi-periphery are asymmetrical. First and foremost, this characteristic results from the following hypothesis:

Hypothesis 3.3. *Most allocation decisions relative to international investments in semi-periphery countries are either or both caused by phenomena in center leader economies or taken by investors located in center economies.*

This hypothesis comes from a few factors. The size and development of financial markets in the center, the greater stability and freer convertibility of the currencies in the center, and size of center leader economies suggest that (on average) investments, savings

[8] A more detailed description of these effects is provided in the online appendix (Subsection B.3.1).

and financial capacities are larger in the center than in the semi-periphery. In addition, changes in investment opportunities and in expected profitability of investments in the center can substantially influence the decisions of center economies' investors to invest abroad (see Section 2.2.1). Finally, financial markets in center leader countries are often more attractive than those of the semi-periphery for other countries' investors. This is illustrated by the large financial investments in center leader countries (notably in the US) by oil-exporting countries after large increase in oil price or the large reserve accumulation of China.[9]

On the one hand, the *volume effect* represents the phenomenon of decrease (resp. rise) in financial inflows due to the global contraction (resp. expansion) of investment during the downward (resp. upward) phase of CLIF cycles. The central idea is that these cycles drive the amount of the global investment around the world because of the economic influence of the center (Hypothesis 3.3). In other words, during expansions in CLIF cycles, firms typically have higher earnings to invest both at home and abroad.[10] We then expect financial outflows of center economies to evolve procyclically with CLIF cycles, and increase concurrently with their domestic investments. Accordingly, following Hypothesis 3.2, capital inflows of semi-periphery countries should display the same procyclical behavior. On the other hand, the *substitution effect* refers to the modification of capital allocations by investors from the center (and the semi-periphery) due to the changes in CLIF cycles.

The substitution effect is (usually) countercyclical with CLIF cycles and can be at the root of disruptive changes in the pattern of financial flows. To underpin this argument, we need to formulate two hypotheses. First, we assume that at least one of these two situations is not too distant from the truth: (i) the decisions on fund allocations by

[9]It can be noted that absorption capacities are (on average) lower for semi-periphery countries, so that foreign investments can affect more their macroeconomic variables (inflation, growth, exchange rate, etc).

[10]Another conventional salient phenomenon happens with financial crises. After a financial domestic stress, center countries invest less and global liquidity decreases. This causes a decrease in investment in the semi-periphery from the center. In some cases, this even leads to the repatriation of capital from the semi-periphery.

investors in the center and in the semi-periphery are affected in a similar way by CLIF cycles, and/or (ii) based on Hypotheses 3.2 and 3.3, we can assume that investment decision made in the center is the main driver of financial flows. Secondly, we are interested in the ratio between net outward investment flow of center countries ${}^{no}\phi_t^c$ and the amount of savings in the center s_t^c, called in this study the *net outward ratio* (of center economies) and noted ${}^{no}\rho_t^c$. Based on arguments developed in Subsection 3.2.1, we introduce the following hypothesis relative to this key measure:

Hypothesis 3.4. *The net outward ratio of center economies is primarily a function of: (i) the average expected relative rate of returns, (ii) the average expected relative risk of assets, (iii) the average relative liquidity of the financial assets, and (iv) the relative looseness/stringency of monetary policies between the two economic areas. To these must be added idiosyncratic domestic pull and push factors (see Hypothesis 3.1).*

Hypothesis 3.4 means that we can define a function f such that the net outward ratio ${}^{no}\rho_t^c$ can be approximated as follows:

$$ {}^{no}\rho_t^c = \frac{{}^{no}\phi_t^c}{s_t^c} \approx f\left(\frac{R_t^s}{R_t^c}; \frac{\sigma_t^s}{\sigma_t^c}; \frac{l_t^s}{l_t^c}; \frac{MP_t^s}{MP_t^c}; P_t^s; \bar{P}_t^s\right) \tag{3.1} $$

where R_t^c and R_t^s are respectively the average expected returns on investments in center and semi-periphery countries, σ_t^* symbolizes the expected average risk of the assets,[11], l_t^* is the average liquidity of the financial assets, and MP_t^* is an indicator of the stringency of monetary policies in the areas.[12] P_t^s and $\bar{P}_t^s$ respectively represent univariate indicators of the average effect of domestic pull and push factors in semi-periphery countries.[13]

Importantly, this decomposition enables us to highlight that the substitution effect

[11]We use σ to refer to the standard deviation, because the variance commonly used as a measure of risk.

[12]A decrease in MP_t^s means that, on average in the semi-periphery, monetary policies are becoming more expansionary. Likewise, the larger the decrease is the more expansionary those policies are. This term can be represented by a general indicator of central bank monetary policy, like shadow rates (see Krippner, 2013; Wu and Xia, 2016). On the importance of the interest rate movements in this context, see Levy Yeyati and Sturzenegger (2000) and Calvo et al. (1993).

[13]For the sake of simplicity, we consider in this subsection the average effect of pull and push factors even if the underlying economic effect is likely to be affected by major nonlinear and distributional effects leading to various heterogeneities and the emergence of financial hot spots.

generates a countercyclical effect between CLIF cycles and the financial flows towards the semi-periphery. Based on the decomposition of the net outward ratio ${}^{no}\rho_t^c$ in its different major components, we have that the net outward ratio is countercyclical to the CLIF cycles:

$$\begin{aligned}
\frac{\partial\, {}^{no}\rho_t^c}{\partial A_t^c} \approx\ & \underbrace{\frac{\partial f}{\partial R_t^s/R_t^c}}_{>0} \times \underbrace{\frac{\partial R_t^s/R_t^c}{\partial A_t^c}}_{<0} + \underbrace{\frac{\partial f}{\partial \sigma_t^s/\sigma_t^c}}_{<0} \times \underbrace{\frac{\partial \sigma_t^s/\sigma_t^c}{\partial A_t^c}}_{>0} + \underbrace{\frac{\partial f}{\partial l_t^s/l_t^c}}_{>0} \times \underbrace{\frac{\partial l_t^s/l_t^c}{\partial A_t^c}}_{<0} \\
& + \underbrace{\frac{\partial f}{\partial MP_t^s/MP_t^c}}_{<0} \times \underbrace{\frac{\partial MP_t^s/MP_t^c}{\partial A_t^c}}_{>0} + \underbrace{\frac{\partial f}{\partial P_t^s}}_{>0} \times \underbrace{\frac{\partial P_t^s}{\partial A_t^c}}_{<0} + \underbrace{\frac{\partial f}{\partial \bar{P}_t^s}}_{<0} \times \underbrace{\frac{\partial \bar{P}_t^s}{\partial A_t^c}}_{>0} < 0,
\end{aligned} \tag{3.2}$$

where A_t^c is an indicator of the CLIF cycles. The signs of the derivatives with respect to R_t^s/R_t^c, σ_t^s/σ_t^c and l_t^s/l_t^c stem from the nature of the CLIF cycles, which synthesize cycles of industrial and financial difficulties in center countries (lower returns, high risk of default, and lower liquidity). The sign of the derivative of f with respect to MP_t^s/MP_t^c is due to countercyclical monetary policies implemented in center economies (Levy Yeyati and Sturzenegger, 2000; Calvo et al., 1993). The sign for P_t^s derives from the assumption that the effects of the domestic pull factors on semi-periphery countries are more likely to be larger during the downward phases of CLIF cycles.[14] Endogenous phenomena increase the likelihood of facing major and detrimental effects of push factors at the end of a cycle of large inflows and are therefore likely to correspond to the upward phases of CLIF cycles (and mutually reinforce each other). Therefore, the sign of the derivative of f with respect to $\bar{P}_t^s$ is assumed to be positive. Importantly, the different terms in this equation are likely to dependent to a certain degree of the CLIF cycles. For example, the sensibility of net outward ratio to average expected relative risks, $\frac{\partial f}{\partial \sigma_t^s/\sigma_t^c}$, might increase with the CLIF cycles because of a lower risk-aversion when the returns are high in the center. However, it seems clear that the various signs for the different derivatives would

[14]Privatization policies, accession to the WTO, pro-business reforms, creation of special economic zone and new financial markets in the semi-periphery are on average more likely to attract foreign investments when center economies' investors do not find, or find with more difficulties, domestic profitable investment opportunities. It is also the case of the impact of favorable publications by international organizations that stimulate investment towards the semi-periphery.

not be changed by the impact of the cycles so that the overall result that net outward ratio ${}^{no}\rho_t^c$ is countercyclical to the CLIF cycles is not altered.

It appears that the volume and substitution effects have opposite implications on the dynamics of financial flows towards the semi-periphery. Yet we argue that global investment is unlikely to vary as abruptly as the net outward ratio ${}^{no}\rho_t^c$ throughout CLIF cycles. This perspective leads to the following proposition:

Proposition 3.1 (countercyclicity hypothesis)**.** *As long as global investment and global liquidity are maintained at a sufficiently high level, the semi-periphery experiences countercyclical capital inflows from the center relative to CLIF cycles.*

This proposition implies that, except for periods of massive contractions in the investment and credit in the center (e.g., during the Great Depression or the GFCs), semi-periphery economies have to deal with a rise (drop) in financial flows into their economies during the downward (upward) phase of the CLIF cycles.[15]

3.2.3 BOP crises in the semi-periphery and CLIF cycles

Relying on cases of BOP crises in semi-periphery countries since the 1970s (see Section 3.3), this subsection outlines how CLIF cycles induce BOP crises in the semi-periphery. The model postulates a pattern of four fundamental phases.[16] Major components and phases are illustrated in Figure 3-1.

t_1 - initialization.

During this first phase, the profitability of investments in center countries is de-

[15] Before exploring the implications of the substitution effects on semi-periphery countries, we must note that most investments occur within the center. Even when several emerging economies of the semi-periphery become very attractive places to invest (i.e., financial hot spots), they do not capture the bulk of investments. One reason is that these economies offer only limited investment opportunities due to much smaller size and depth of their markets. Their industrial capacities are often also limited. For example, portfolio investors are attracted to the center by the depth and the scope of the most sophisticated financial markets. In addition, even in overcapacity periods, portfolio investors can move to venture capital in high-tech start-ups located in specific Research and development (R&D) Marshallian districts located in the center.

[16] These stages can have varying length and significance depending on domestic and international characteristics. In addition, they may overlap widely, particularly if we apply the model to the semi-periphery as a whole (as in Section 3.3).

creasing relative to their recent standard and semi-periphery countries. All things being equal, this low profitability triggers or increases the willingness of center countries' investors to allocate a bigger part of their fund in semi-periphery economies (the substitution effect). As explained in Subsection 1.2.4, the downward phase of a CLIF cycle is characterized by low profitability in financial investment and industrial overcapacity. The former encourages diversification towards foreign financial products, the latter generates a contraction in the profitability of firms and investments in productive sectors. To maintain profitability rates, MNEs of the center have lesser incentive to invest in new domestic production capacities and have a still greater need to cut costs. The result is a relative rise in the attractiveness of the semi-periphery as a source of profit. Given their specific position in the center-periphery continuum, semi-periphery countries may be characterized by a large number of underemployed and low-paid workers while benefiting from sufficiently effective communication and transport infrastructures to be inserted in IPNs (see Section 1.2.3). These features make them perfect places to allocate funds in the eyes of center countries' investors.

Major institutional, economic, and/or political pull factors steer investments in a few semi-periphery countries (Subsection 3.2.1). These factors include adoption of structural reforms, withdrawal of capital control policies, adoption of specific monetary policies (e.g., pegging, currency board), privatization of large SOEs, tax break, creation of free-trade and export-processing zones with specific tax and labor law rules, improvement in potential competitiveness gain from recent devaluations, conclusion of multilateral and bilateral trade agreements, and/or improvements in the protection of intellectual rights. In addition, a change in the willingness to borrow abroad in a hard currency (due to the constraint of the "original sin") might act as a additional factor. Some areas in the semi-periphery may additionally benefit from international pull factors. This can include an economic blossoming of domestic specializations (e.g., large oil supply capacities during an oil price boom) or international valorization (e.g., by international institutions or think-tanks). The combination of a period of low profitability in financial and productive investment in the center (the downward phase of the CLIF cycles) *and* the effects of international and domestic pull factors stimulate large financial flows towards the semi-periphery.

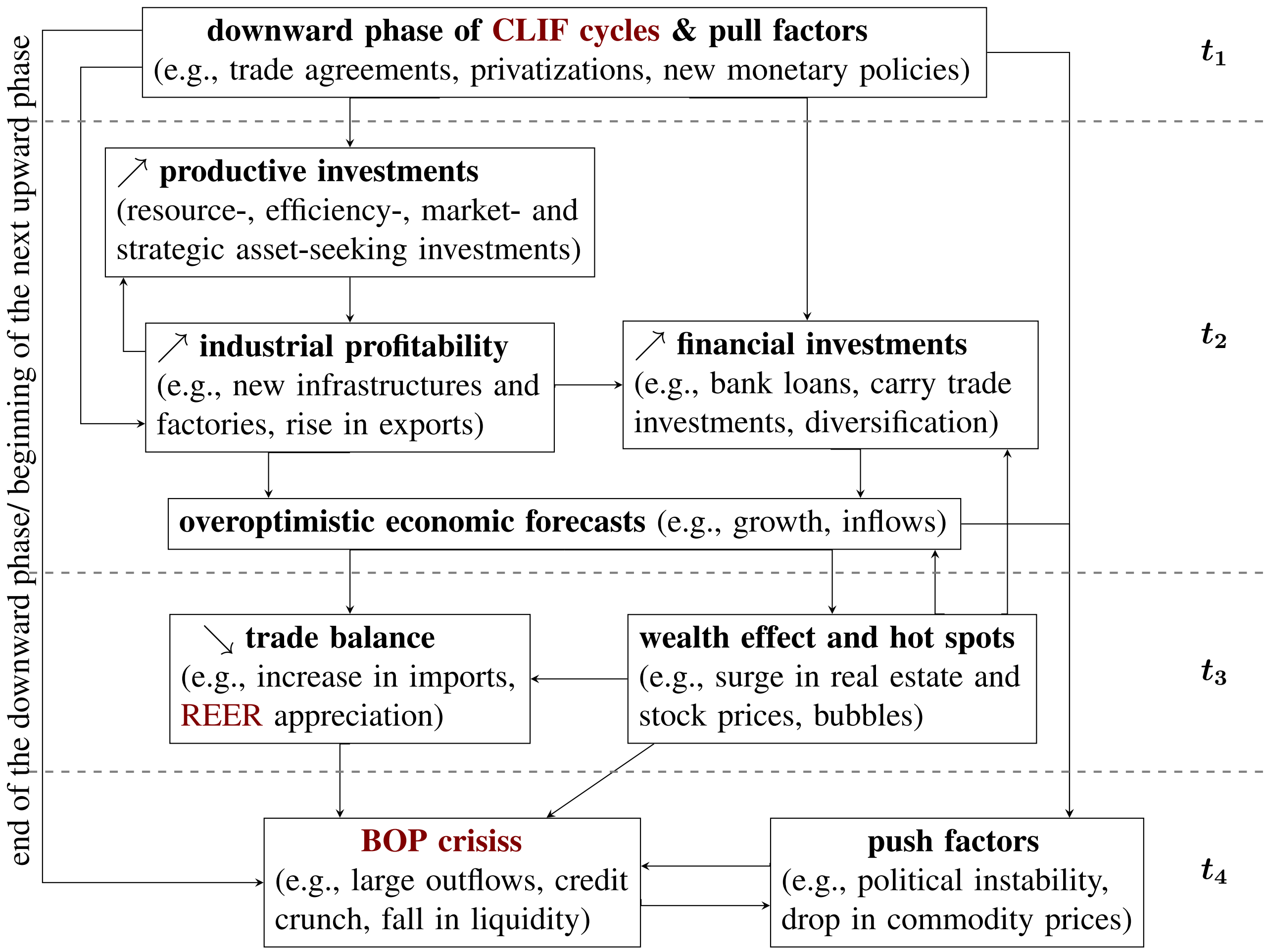


Figure 3-1: Schematic of BOP crises in the semi-periphery caused by the CLIF cycles.

The figure summarizes the model of BOP crises in the semi-periphery introduced in Subsection 3.2.3. It schematizes the induction of BOP crises in semi-periphery countries rooted in the dynamic of the medium-term industrial and financial cycles of the center economies. Arrows indicate causal effects that are prone to happen (even if specific institutional, economic and political contexts can prevent or restrain the development of some effects). The periods t_1, t_2, t_3 and t_4 signal the chronology of the economic phenomena.

t_2 - surge in inflows.

Semi-periphery economies that are experiencing large capital inflows improve their domestic macroeconomic situation. These financial flows increase or hasten the industrialization of the country (e.g., new mines, new refineries, new factories) and the reallocation of underemployed labor from rural to new export-oriented manufacturing areas. New transport, logistics, energy, and telecommunication infrastructures are developed. Productive investments increase the mobilization of resources (labor and capital). Potential large efficiency-seeking and strategic asset-seeking FDI can also increase industrial labor productivity through many channels, such as spillovers in terms of management and technology know-how. The rise in mobilization of resources, industrial productivity and/or the preconditions attracting financial flows (namely, pull factors happening in $\boldsymbol{t_1}$) lead to an increase in industrial profitability (and/or decrease the financial risks). This subsequently attract financial investments. Indeed, new blossoming company shares are issued and domestic macroeconomic conditions improve, thus enhancing confidence in domestic financial markets (e.g., external debt defaults are regarded as less likely to happen). Moreover, the anticipation of currency appreciation (e.g., due to trade surplus driven by export-based industrial improvements), high interest rates in the period of high growth (large interest rate differentials can trigger massive carry trade investments), and/or political stability arising from macroeconomic improvements steer portfolio investors to lend more to some semi-periphery countries. The large reduction in borrowing constraints from international investors and foreign banks (either or both due to an international pull factor in $\boldsymbol{t_1}$ or macroeconomic improvements in $\boldsymbol{t_1}$ and $\boldsymbol{t_2}$) as well as the domestic relaxation of financial constraints and regulations on foreign investments are two additional pull factors that improve the macroeconomic situation of the countries which originate from phase $\boldsymbol{t_1}$ and reinforce each other and the macroeconomic trends in the short-term.[17]

During this phase, semi-periphery economies experience a rise in GDP, as well as a surge of exports and most often of foreign exchange reserves. The development of

[17] Sometimes, some semi-periphery countries have purposely implemented capital policies to restrain financial inflows in $\boldsymbol{t_2}$ and $\boldsymbol{t_3}$ to avoid large outflows in $\boldsymbol{t_4}$ (e.g., see Subsection 3.3.3).

welfare policies (food subsidies, education and health policies) is a common characteristic. The accumulation of reserves, financial inflows, and Balassa-Samuelson effect create multiple inflationary pressures. Yet the large inflation in securities provoked by the spike in cross-border investment inflows attract even more inflows from the rest of the world. This tends to limit upward pressures on goods price levels due to the rise in the value of the domestic currency and hence the decline in the domestic prices of imported goods.[18]

This period of rise in productivity and low international borrowing constraints is sometimes viewed as unceasing. The resulting illusion of limitless economic growth blinds many economists, politicians, and portfolio investors to the actual economic consequences and unsustainability of these trends. As in many countries of the center, from the end of this phase ($\boldsymbol{t_2}$) to the crash ($\boldsymbol{t_4}$), many actors involved do not understand the limits of the current developments (e.g., Prebisch-Singer hypothesis) and/or convince themselves of the widespread "this time is different" prophecy (Reinhart and Rogoff, 2009).

$\boldsymbol{t_3}$ - unsustainability.

This third stage is typified by several unsustainable macroeconomic trends: financial euphoria, a rising REER and a degradation of the competitiveness.

Overoptimistic anticipation of growth, loose international credit access, abrupt financial deregulation, and/or reduced compliance with financial prudential rules stimulate short-term financial investments. These inflows are commonly more volatile and strengthen existing real-estate and financial bubbles as well as governments' borrowing. In general, these intertwined bubbles increase the prices of real estate, stocks, and bonds.[19] Local corruption usually increases procyclically, and the phase

[18]The central banks of the semi-periphery countries involved may have to deal with a dilemma if on one side the inflation rate for goods and services corresponds with their inflation target while on another side the financial assets experience inflation higher than what is desired or viewed as stable.

[19]Interestingly Aliber and Kindleberger (2017) explain that many bubbles in stock markets are connected to bubbles in real estate; "*[T]here are three different connections between these two markets. One is that in many countries, and especially smaller countries and those in the early stages of industrializa-*

is associated with a surge in inefficient, shorter-sighted, and self-invested investments (Aliber and Kindleberger, 2017).

These price increases generate a wealth effect. Households' spending increases as their borrowing constraints become almost irrelevant because their house prices and wages soar.[20] Cheap borrowing conditions generate possibilities to adopt unsustainable economic policies by public authorities.[21] Financial and industrial firms are also likely to increase their own spending and debt with the rise of their stock prices and/or their real-estate acquisitions. The wealth of domestic households, governments, and private firms increases, which reduces the willingness of major actors to cool down the economy and deflate these bubbles.

The aggregate rise in spending increases the value of imports and tends to deteriorate the trade balance. Three major additional factors pressure the balance of trade. Firstly, the upsurge in industrial costs, and foremost the rise of wages, can bring about a large rise in the REER and a decline in terms of international competitiveness and subsequent loss of international market shares, bringing down exports. Secondly, an implication of large financial inflows can be a fast appreciation of the currency (vis-à-vis the dollar, the euro, the yen, or other competitors' currencies), which accentuates the deterioration of the trade balance. Thirdly, in several semi-periphery countries, mainly those having a export-surge of commodity, potentially combined with a major shift in economic policy, we can also observe a rise

tion, the market value of real estate companies, construction companies and of firms in other industries closely connected with real estate including banks accounts for a relatively large share of the aggregate stock market valuation. A second connection is that individuals whose net worth has increased sharply as a result of the increase in real estate values buy stocks to diversify their wealth; there aren't many other ways to diversify wealth. The third connection is the mirror-image of the second; the individual investors who have profited extensively from the increase in stock market valuations buy larger and more expensive first homes and they also buy second homes."

[20]The effect on wages is likely to be more important in countries exporting manufactured goods. The urbanization process generated by macroeconomic trends in $\boldsymbol{t_1}-\boldsymbol{t_3}$ increases the concentration of workers, potentially decreases the unemployment rate, and accentuates or creates workers' unionization. These factors can lead to a sharp rise in wages.

[21]For example, costly Import Substitution Industrialization (ISI) projects with limited local technological know-how; prestigious infrastructure and building schemes, many of which turn out to be "white elephants"; a rise in the number of civil servants for political and social stability purposes; and the development of welfare programs.

in the REER characterizing a "Dutch Disease" (Corden and Neary, 1982; Corden, 1984) and a certain degree of premature de-industrialization (Palma, 2011; Rodrik, 2016). Those countries experience a fall in their manufacturing employment and in their manufacturing value added share associated with a booming primary sector.[22] This dynamic increases their external dependency to the international commodity prices and accentuates the vulnerabilities of the balance of trade of these economies because of the higher price elasticity of commodities compared to differentiated manufactured products (Poelhekke and van der Ploeg, 2007; Jacks et al., 2011).

Overall, the domestic economy experiences a large liquidity glut. This can be inflated and/or hastened by accommodating domestic monetary and loose macroprudential policies. Industrial investments account for a declining share in the mix of financial flows. Macroeconomic trends become increasingly unsustainable and driven by financial effects, while the industrial development of the first phases contributes less to domestic macroeconomic growth.

t_4 - crash.

The macroeconomic state in t_3 is intrinsically unstable. The addition of specific domestic or international push factors brings about a disruptive macroeconomic distress. This change is mostly characterized by a considerable shift in net financial flows (the emergence of large capital outflows and/or the plunge of capital inflows) and a liquidity collapse. The push factors involved can be of very different nature. Some can be international economic shocks, such as a brutal change in monetary policy in center countries and/or a fall in commodity prices. Domestic push factors are additional triggers for the distress (e.g., the anticipation of a possible devaluation by international investors due to the cumulative trade deficits or a political instability). As many semi-periphery countries suffer from the original sin (Eichengreen et al., 2002, 2007), they have to pay back their external debt in foreign currency in a pe-

[22]This must be distinguished from the de-industrialization in the center characterized by a rise in advanced high value-added services.

riod of high devaluation risk and inflation. This factor accentuates the panic among international investors and therefore the balance-of-payment difficulties. Last but not least, the upward phase of the CLIF cycle and the return to a state of higher profitability in center economies attract international investors and increasing shift away from the semi-periphery. Because the CLIF cycle are usually correlated with periods of US dollar appreciations, the upward phases of the CLIF cycle also pressure down commodity prices and deteriorate the exports of several semi-periphery countries.[23]

Sudden capital outflows, plunging domestic liquidity and loss of access to international credit are the main characteristics of the BOP crises. The host semi-periphery economy can also experience the burst of the real-estate bubble, banking crises, currency crashes, sovereign domestic and/or external default (or restructuring), inflation crises, stock market crashes, etc. leading to a potential massive GDP contraction with serious consequences in terms of social costs and political instability. This macroeconomic shock is usually followed by painful macroeconomic adjustments.[24]

The main point highlighted by this sequence for this paper can be summarized as follows:

Proposition 3.2. *CLIF cycles contribute to trigger BOP crises in the semi-periphery, through the pattern of international financial flows they generate.*

3.3 Historical assessments

This section proposes an appraisal confronting the model introduced in Section 3.2 (in particular the model developed in Section 3.2.3) with a historical review.[25] Specifically,

[23]According to IMF (2008b), the most important direct impacts are on oil and gold, followed by metals.

[24]This scenario is not the only possible outcome but characterize a set of common characteristics. If an economy switches to more intensive growth, the recession generated by the financial crisis will be solved by exporting medium or high-tech manufactured goods and services. Interestingly, Hansen and Wagner (2022) show that large retained earnings FDI can lower the probability of BOP crises. Based on diverse macroeconomic indicators (e.g., productivity, GDP per capita, diversification of exports, rising share of high-tech exports and share of GDP spent on R&D), South Korea, Singapore, Israel, Taiwan and the Czech Republic are among the few economies that managed to adopt a more intensive growth.

[25]The interconnections between numerous political, economic, and institutional changes, the lack of available data (particularly for semi-periphery countries - notably those of the Eastern bloc - during the

the goal of this section is to revisit the main recent and known episodes of financial crises in the semi-periphery to show that these historical events fit into the model. We concentrate the analysis on three waves of BOP crises in the semi-periphery following the financial liberalization in center economies. The three periods (1970-90; 1991-2001; 2002-2019) can be distinguished regarding the evolution of the nature, magnitude and, impact of international financial flows between center and semi-periphery countries.

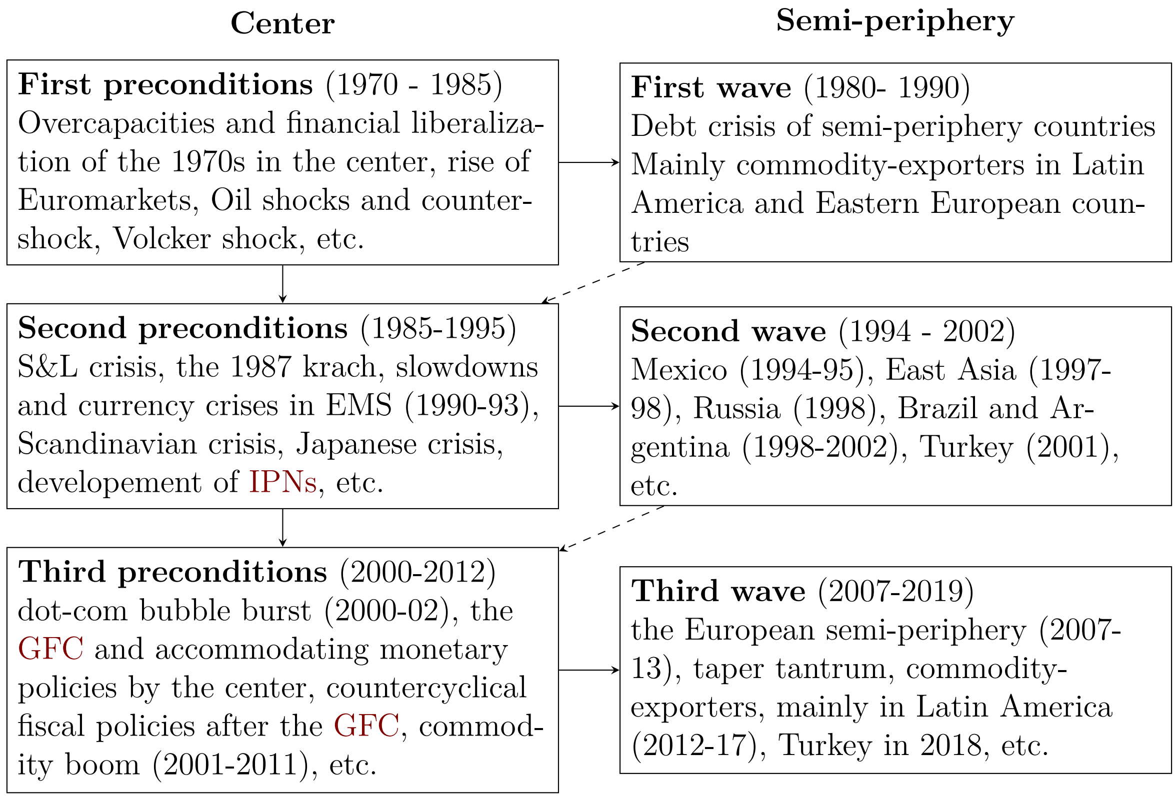


Figure 3-2: Periodization and waves of BOP crises in the semi-periphery.

Figure 3-2 summarizes the perspective. The first period is characterized by low interconnections of financial markets between the center and the semi-periphery, large bank loans to the semi-periphery, disruptive oil shocks, and the dramatic increase in the interest rates in the US around the turn of the 1980s. The second period is marked by a greater economic integration of several semi-periphery countries into the global economy with the development of IPNs, a surge in FDIs and portfolio investments into the semi-periphery,

1970s and the 1980s) and the variety of the phenomena that act as pull or push factors challenge the assessment of the theoretical model. We develop this historical review to cope with these difficulties. Quantitative assessments of Propositions 3.1 and 3.2 are developed in Chapter 2.

and the collapse of the USSR. The end of the second period brought about BOP crises between 1994 and 2002. The third period is characterized by the real-estate and financial bubble of the early 2000s, the resulting GFC, the slowdown of the Chinese economy and the "taper tantrum" during the 2010s, as well as accommodating monetary policies.[26]

3.3.1 The first period: 1970-90

The roots of the first wave of BOP crises, conventionally dubbed the *debt crisis (of third world countries)*, were the disruptive international economic changes of the 1970s. These financial dynamics were disclosed by many bankruptcies among semi-periphery countries in the early 1980s.

t_1 - initialization.

A. Downward phase of the CLIF cycles. The growth and productivity rates of center economies started to slow down in the late 1960s. The profitability rate of US companies declined by 1967, followed by European enterprises in the early 1970s. The global economy experienced a very short-lived boom in 1972-73. Yet the CLIF cycles decreased sharply after 1973 (see Figure 3-3) and triggered many disruptive structural changes among which a decrease in the relative expected returns between center and semi-periphery countries (e.g., see Kolko, 1988; Aglietta, 2000; Duménil and Lévy, 2004). The first oil shock of 1973 was detrimental for center economies, with a considerable downward phase in both the financial and industrial sides of the CLIF cycles. Overall, at least until 1977, there was less destabilization in the net oil-importing semi-periphery countries than in the center, with their growth rates only slightly reduced (Hallwood and Sinclair, 1981; Easterly, 2001). Investors

[26]The model of induction of BOP crises (encapsulated in Figure 3-1) firstly concentrates on single countries in the semi-periphery. To exemplify how the model can explain waves of BOP crises in the semi-periphery (perceived as a whole) and to not limit the historical assessment to isolated case studies, the analysis focuses on financial hot spots and major episodes that affected the semi-periphery. This implies that overlaps exist between some phases of the model given that many countries were involved. An example, among many others, is that when Mexico experienced a BOP crisis in 1994-95 (phase t_4 - crash) several South East Asian economies and Russia were still at the beginning of the process (phase t_1 - initialization or t_2 - surge in inflows) and large financial flows were yet to come.

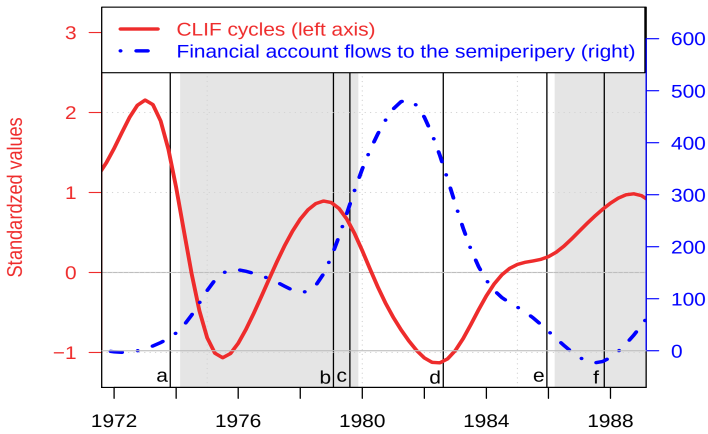


Figure 3-3: CLIF cycles and the semi-periphery's financial account during the first period

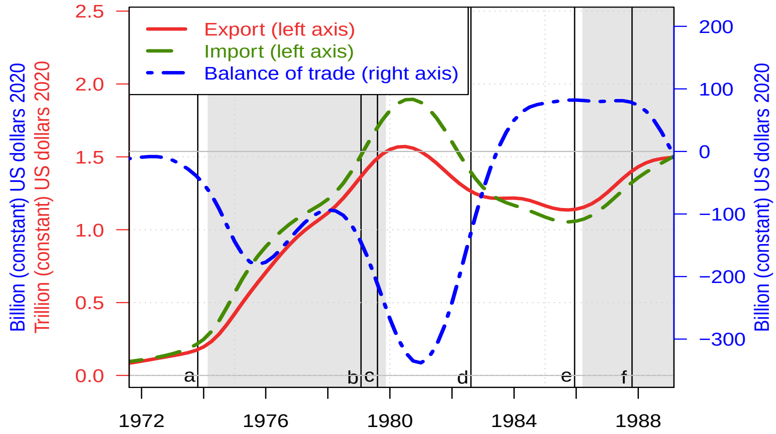


Figure 3-4: The semi-periphery's trade flows during the first period

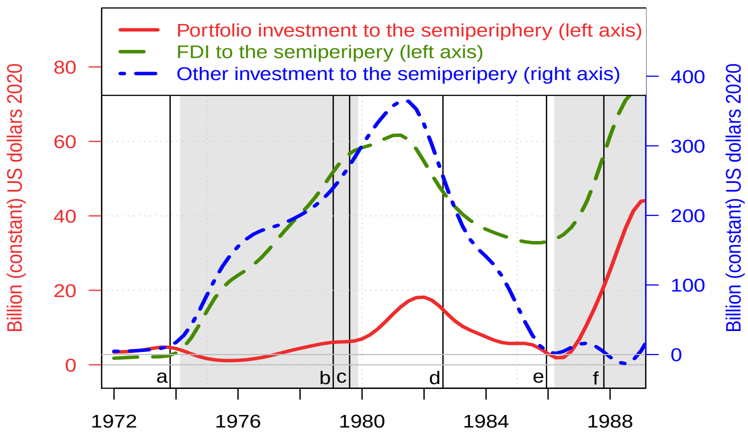


Figure 3-5: The semi-periphery's net financial flows during the first period (positive = net inflows)

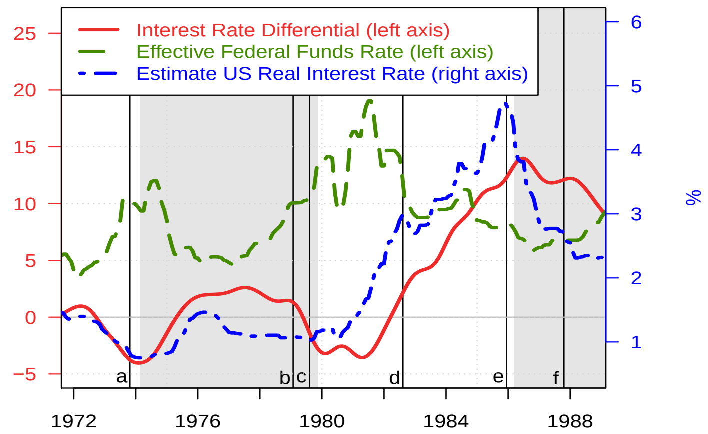


Figure 3-6: Real and nominal interest rates in the US and interest rate differential during the first period

The top left chart exhibits an estimate of CLIF cycles and the financial account flows to the semi-periphery such as defined in the online appendix (Subsections 2.2.3 and A.2.5)[a] The top right chart displays the exports and imports for the semi-periphery countries based on the IMF's Balance of Payments and International Investment Position dataset. The trade balance is the difference between the two variables and is positive when the exports exceed the imports. The bottom left chart shows the different financial inflow categories from the IMF's Balance of Payments and International Investment Position dataset for the semi-periphery. Other investments notably include bank loans. The bottom right chart indicates the effective Fed Funds rate, an estimate of the US real interest rate (the difference between the 10 Year treasury bill rate with the rate of inflation based on the GDP deflator). The chart also exhibits an estimate of the interest rate differential between center leader and semi-periphery countries (the difference in terms of median nominal interest rate between center leader and semi-periphery countries). In all chart, red and green lines (respectively blue lines) are associated with the left (resp. right) axis.

Some key disruptive dates and periods used in the text are respectively represented on these charts by vertical black lines and gray areas. The event "a" refers to October 1973 first oil shock. The event "b" indicates the moment of the Iranian revolution and the beginning of the second oil shock. Paul Volcker became the Chair of the Fed's Governor Board in the August 6th, 1979 as exhibited by the line "c." The event "d" represents the August 12th, 1982 announcement of the Mexican external debt default. The event "e" is the beginning of the counter oil shock when Saudi Arabia abandoned their role as swing producer and began producing at full capacity in December 1985. The event "f" corresponds to the Black Monday (NYSE crash) on October 19, 1987. The first gray area represents the period marked by the upsurge in international liquidity and negative or very low real interest rates due. The second gray area exhibits the Savings and Loans (S&L) crisis in the US.

[a]Due to the lack of data for many countries, the financial flows before 1977 are underestimated and have to be considered with caution. The important and reliable characteristics of the curb is the rise between 1979 and 1981 and the subsequent sharp drop of the financial inflows.

therefore increased their investments in the semi-periphery simply based on relative macroeconomic performances between the countries.

Interest rates on US dollar demand deposits were subject to ceilings that the Fed had adopted to limit competition among banks in the 1930s. These ceilings did not apply to interest rates on eurodollar deposits (in London and other center economies), which increased and induced investors to move funds from domestic to offshore financial centers, and then de facto created the embryo of the future Euromarkets (Burn, 1999; Schenk, 1998), and at very low real interest rates (e.g., see Figure 3-6). In addition, the Fed adopted a more expansive monetary policy in 1971 (when the US economy slowed and the inflation rate declined), and the drop in domestic interest rates led to larger investment flows to other center economies. Subsequently, Germany and Japan responded to their rising surpluses by increasing the money supplies. The depreciation of the US dollar and the rising money supply increased the demand for primary products, and hence in the prices of oil, wheat, and many other commodities (Aliber and Kindleberger, 2017). The terms of trade in the semi-periphery countries that produced these primary products improved and the exports of the semi-periphery surged (see Figure 3-4).

B. Major pull factors.

The first oil shock triggered a sharp increase in oil prices. Two major global financial consequences on semi-periphery countries resulted. Firstly, the excess savings from the Organization of the Petroleum Exporting Countries (OPEC) generated massive additional inflows to the emerging Euromarkets. The upsurge in the size of eurocurrencies bank accounts compelled private banks of the center economies to reach out for new lending opportunities (Kolko, 1988; Cassis, 2010; Conti-Brown and Lastra, 2018). In that regard, Cassis (2010) explains: "*Between 1974 and 1980, these [oil-exporting] countries accumulated United States dollar (USD) 38 billion in liquid assets, half of which was invested as short-term bank deposits with the biggest American and European banks. These deposits had all the characteristics of Eu-*

rodollars – mobility and an absence of control by a national authority – and swelled the already existing pool of Eurodollars. [...] a solution for placing or 'recycling' these new Eurodollars, dubbed 'petrodollars', needed to be found. From the outset, the main banks involved, above all Citibank from New York, envisaged lending these funds to developing countries, whose public and trade deficits increased sharply following the oil price hike, with the at least tacit approval of Western monetary authorities." The excess liquidity generated low real interest rates for international loans (see Figure 3-6).[27] Secondly, new oil-producing countries emerged from the semi-periphery, as their oilfields had become exploitable (e.g., Mexico, Indonesia and Nigeria). These countries required external financing to invest in these new industrial projects.[28] After 1973, investors of the center massively increased their investment in semi-periphery countries (see Figure 3-5) because they anticipated large profitability of investments in some commodity-exporter economies or because others, which needed financial resources to deal with the surge in oil prices, progressively agreed to relax their state-led ISI strategies and to increase their foreign debt.[29]

In the context of decreasing geopolitical tensions and rising economic cooperation (e.g., trade and tourism) characterising the "détente", countries of the Eastern Bloc increased their economic integration with the capitalist system (Berend, 1996; Sanchez-Sibony, 2014). Their access to external financing improved and their debts surged partially because of the large excess liquidity of the center economies and the

[27] The London Inter-bank Offered Rates (LIBORs) and subsequently almost all short-term international rates became negative in real terms in the early 1970s.

[28] A third impact can be added. Slower GDP growth rates and increases in trade barriers in the center led to a decrease in imports of the primary commodities exported by the net oil-importing semi-periphery to center countries after the oil shock. These factors fed the deficit of the balance of payments of net oil-importing semi-periphery. This increased the need for external financing. Yet, as explained by Hallwood and Sinclair (1981), "*the extent of this difficulty very quickly came to be mitigated for a number of non-oil LDCs [less developed countries], however, by rapidly growing markets in many OPEC Member Countries*".

[29] Up to the early 1980s, international capital movements were dominated by commercial bank credit (Figure 3-5). After the second oil shock, net oil-importing semi-periphery countries in need of financial resources liberalized their economies even more (e.g., Tunisia) and the share of FDI and portfolio investments slightly increased but remain limited - particularly relative to the next periods (compare Figures 3-5 and 3-9).

view that centralized economies could be more efficient and creditworthy, (Berend, 2016; Zloch-Christy et al., 1987; Kolko, 1988; Defraigne and Nouveau, 2021). These economies had been more isolated than most other countries from international conditions and more resilient to the first oil shock.[30]

t_2 - surge in inflows.

The very low real interest rates led to a massive increase in bank loans taken out by semi-periphery countries engaged in industrialization programs requiring the acquisition of expensive technology from center economies and in public spending on infrastructure (some were "white elephant projects" that fueled corruption among the local political elites). Moreover, in Latin American and some Asian countries, the US banks responded aggressively to what they saw as an encroachment by other center countries on what had been their turf by decreasing their interest rates to minimize the decline in their market share (Aliber and Kindleberger, 2017). This meant that these semi-periphery countries could increase their debt through very cheap loans.

Most international financial flows to the semi-periphery were bank loans (Oman, 1996a,b). FDI flows going to these economies were very limited (see Figure 3-5), partially because they were relatively closed to international investments, and were mostly resource-seeking and market-seeking (Oman, 1994). These investments thus did not enable these economies to insert themselves into IPNs. Rising key macroeconomic fundamentals, and primarily the evolution of world commodity prices and

[30]Two international pull factors can be mentioned. Firstly, the collapse of the Bretton Woods system in the early 1970s multiplied the flexible exchange rate regimes in center economies that created incentives for a new wave of international financial flows. Likewise, several semi-periphery countries started to relax capital controls to become more integrated with the major financial centers (Conti-Brown and Lastra, 2018). Secondly, many companies of the center started to internationalized their production in the 1960s and 1970s. These MNEs increased their investment in the semi-periphery for many reasons, including the preferential tariff system for manufactured products from the semi-periphery and periphery granted in 1968 by the center (the Generalized System of Preferences), the geopolitical support by the US to the future four Asian tigers, the creation of a customs union in Europe (with the adoption of a common external tariff in 1968), the return of "social peace" in the late 1960s at the cost of wage increases in the center.

trade balances, favored large investments in the semi-periphery and generated foreign exchange reserves.

High growth rates in the commodity-producing semi-periphery countries in the 1970s led to the growth of bank loans to governments and SOEs (e.g., Mexico, Brazil, Argentina). These countries were more attractive borrowers because the lenders from the center anticipated that their fiscal revenues would increase more rapidly. Banks headquartered in the center used US dollars that they borrowed in the Euromarkets to fund these loans (Cassis, 2010).[31] Likewise, some analysts expected that the terms of trade between manufactured goods and commodities would continue to be more and more favorable to net commodity-exporter semi-periphery countries (Kolko, 1988; Bulmer-Thomas, 2003; Lustig, 2000). Some policymakers based their political perspectives on this fond belief. This overoptimistic forecast for terms of trade and the ease of access to financial resources fueled economic illusions among some political elites in semi-periphery countries, namely that they would soon be able to compete on an equal footing with center economies.

Due to their privileged access to the USSR markets and energy resources as well as their low integration into capitalist economies, European countries in the Eastern Bloc were more isolated from the global economic environment than semi-periphery countries in the capitalist system. They were less affected by the 1970s crisis touching center economies and their growth rates were high. Therefore, neither investors nor the political elites of those countries questioned the ISI policies that fuelled their external debt (Berend, 2016). The Comecon had important collaterals in terms of raw materials and enjoyed a high degree of creditworthiness among Western banks (Kolko, 1988; Zloch-Christy et al., 1987).

t_3 - unsustainability.

The level of external debt of the semi-periphery increased tenfold during the 1970s

[31] Previously most of these semi-periphery borrowers had relied on US banks and on institutions like the World Bank for the bulk of their external financing.

(partially to finance their rising trade deficits despite their increasing exports; see Figure 3-4).[32] The surge in the flows of money to many semi-periphery countries concentrated around certain places (e.g., Mexico, Brazil, Poland), enabling these countries to finance larger trade deficits. This cheap borrowing generated unsustainable economic policies; costly ISI projects involving limited local technological know-how,prestigious infrastructure and building schemes, development of welfare programs (food subsidies, education, and health), and considerable hiring of civil servants for political and social stability purposes (Oman, 1994; Defraigne, 2016; Bulmer-Thomas, 2003).

The end of the Carter expansionist program and the Volcker shock[33] in 1979 generated a colossal contraction of international liquidity and a surge in international interest rates (Kolko, 1988). The external debt of many semi-periphery economies shifted to an unsustainable dynamic as debt rollovers became increasingly costly. Moreover, the economic recession resulting from the monetary contraction induced a decline in demand for commodities from center economies. Commodity prices fell between 1980 and 1986 (Hua, 1998; Borensztein and Reinhart, 1994). The rapid rise in the ratios of foreign debt outstanding and service to export in most Latin American countries by 1980 could and should have warned the Western banks. It was not the case.[34]

In addition, the oil counter-shock starting in December 1985 led to an abrupt and massive drop in oil prices. Overall, the trend in the terms of trade widely diverged from the expectation that it would continue to be favorable to the economic development of semi-periphery countries (Lustig, 2000). Both the volumes and prices of

[32] Berend (2016) and Zloch-Christy et al. (1987) estimate that the debt of countries in central and eastern Europe multiplied by around 13 between 1970 and 1980.

[33] The "Volcker shock" refers the large and disruptive increase between October 1979 and July 1981 of real and nominal Fed Funds rates (Figure 3-6) initiated after the start of Paul Volcker's tenure as chairman of the Fed and following an rising trend in nominal Fed Funds rate since the beginning of 1977.

[34] A few weeks before Mexico's default, the risk premiums were very low and unresponsive to the increase in financial charges. These crises were characterized by considerable undervaluation of sovereign risks by commercial banks of the center.

semi-periphery countries' exports declined (Figure 3-4).

t_4 - crash.

The Volcker shock and the collapse of oil prices in the 1980s forced many semi-periphery countries to introduce drastic cuts in public investments, reduce public sector hiring, and curtail safety nets. Several countries were caught in a vise-like grip between the decline in their exports and the increase in the interest rates on their US dollar denominated debts. The combination made it impossible for them to manage their external debts (Cuddington, 1989). Mexico's declaration of insolvency (August 13, 1982) can be considered the first globally acknowledged manifestation of the debt crisis.[35]

After Mexico suspended its debt service, banks of the center abruptly cut off credit to almost all semi-periphery countries to avoid possible defaults, devaluations, and taxes..[36] This triggered brutal and sudden stops to the flows of private loans destined to semi-periphery countries (see Figure 3-5). Therefore, many other defaults followed. This was caused by the complete and unanticipated change in the international monetary system triggered by the Volcker shock *and* the abrupt readjustments in risk evaluation by commercial banks of the center. Its disruptive international push factor, applied to various financial structures weakened by the previous undervaluation of credit risks, transformed localized sovereign debt difficulties into a systemic crisis. Accordingly, commercial banks reduced the terms of the loans and denominated them at floating rates. Previous loans that had reached maturity were replaced by credits at much higher rates. Shorter loan terms increased debt service at a time when the global recession squeezed export earnings.

As soon as in September 1982, financiers from the center at the General Assembly

[35]However, we have to note that some semi-periphery countries experienced economic crisis with common roots before. For example, in 1980-81 Poland had been shaken by a massive economic crisis.

[36]Private banks indiscriminately restricted all Latin American debtors to access to new credits and relied on authorities to manage stocks of insolvent debt. By the end of 1982, new private credits were almost only available to high quality Asian borrowers (Aglietta and Valla, 2017).

of the IMF and the World Bank in Toronto worried about a possible asphyxiation of the international financial system and the risk of a chain of bank bankruptcies involved in Latin America. Central banks of the center provided an emergency monetary support to assist ailing banks, restructure the financial system and support borrowers (Aglietta and Valla, 2017; Conti-Brown and Lastra, 2018). They arranged a public loan to the Mexican government through the BIS and persuaded commercial banks to roll over Mexican banks' loans to avoid the collapse of that country's banking system. Concurrently the Fed began to progressively loosen its monetary policy. With the general liquidity crisis halted, Western governments and the IMF got down to the macroeconomic adjustments of semi-periphery economies in insolvent conditions.

Many semi-periphery countries underwent very high inflation rates and many declared themselves insolvent as they suffered from triple crises (Conti-Brown and Lastra, 2018) - currency, banking and sovereign debt crises.[37] It progressively appeared to be necessary to reschedule their debts,[38] to grant them new loans, and eventually to cancel a fraction of their debts[39] and/or transform them into marketable assets (notably through the 1989 Brady plan for Latin American countries).

t_5 - aftermath.

Many semi-periphery countries were constrained to adopt wide-ranging macroeconomic stabilization policies, Structural Adjustment Programs (SAPs), and privatization programs (Gindin and Panitch, 2012; Ramamurti, 1992). Yet reactions were varied, from Mexico's immediate declaration of insolvency followed by a SAP based on increasingly opening up domestic economic trade and investment and on

[37]Among the first and most notable are: in 1982, Mexico, Venezuela, Argentina, Nigeria and Turkey; in 1983, Brazil, Chile, Morocco, Yugoslavia and the Philippines; in 1984, Peru, Egypt and Myanmar; and in 1985, South Africa.

[38]For example, Mexico and Venezuela obtained from their creditors a vast agreement to reschedule their external debts in September 1984.

[39]For example, in 1988, following the G7 summit in Toronto, the creditor countries of the Paris Club decided to implement a reduction of the stock of debt of poor countries, under what was called the "*Toronto terms*".

privatization programs, to Ceausescu's full reimbursement of the debt through the imposition of devastating austerity constraints in Romania (Lustig, 2000; Berend, 1996; Collier and Gunning, 1999). What was common, however, was that despite diverse degrees of industrial development within affected semi-periphery countries, most were primary export-oriented economies that had never developed a substantial share of manufactured goods in their total exports or, if they had, these manufactured exports were almost exclusively destined for the neighboring (very often, semi-periphery) economies.

The export-oriented recoveries out of the recession targeted by the IMF dragged on for more than a decade. This long and deleterious process was partially due to low prices for commodities, which itself was primarily caused by three factors: (i) the slower demand for commodities from center economies (Hua, 1998; Borensztein and Reinhart, 1994; Stuermer, 2018), the higher price elasticity of commodities compared to differentiated manufactured products, and the rising global supply due to the SAPs to that recommended higher levels of exports to more than 50 indebted economies simultaneously in a time of global recession (Defraigne, 2016). For many indebted semi-periphery countries the crisis lasted until the beginning of the 1990s. Many of those heavily affected by the debt crisis experienced relative premature de-industrialization due to the enforcement of SAPs in the 1980s and 1990s (Collier and Gunning, 1999). At the end of the process, almost all semi-periphery countries gave up their ISI strategies.

The consequences of the debt crisis, including drastic devaluations, hyperinflations, austerity measures, GDP contractions, and socio-political instabilities, explain why FDI flows and growth rates did not progress in most of the semi-periphery during the 1980s (Kaminsky and Pereira, 1996). The numerous defaults generated a loss of creditworthiness for these countries. As the Club of Paris replaced the private banks' Club of London for the management of the debt crisis, Official Development Assistance (ODA) flows replaced private bank loans as the main source of financial flows from the center to the semi-periphery. In the 1980s, the financial centers of center economies, which progressively switched to the upward phase of the CLIF cycles (Figure 3-3), attracted back financial flows. US interest rates were rising and the US dollar appreciating, which pressured down commodity prices. Important changes in the regulation of financial activities (e.g., the *de jure* liberalization of financial flows in the US and the UK, the "Big Bang" in the UK, and the early 1980s financial deregulations in the US) and financial innovations (e.g., the extension of futures contracts to real exchange hedging) generated buoyant activities for these financial centers.

3.3.2 The second period: 1990-2002

The second wave of BOP crises started in the 1990s as many semi-periphery countries began to stabilize their macroeconomic situations and many center economies experienced the downward of their industrial-financial cycles. The hallmarks of this wave are the 1994-95 Mexico "Tequila" crisis, the 1996-97 South East Asian crisis, the 1998 GKO Russian crisis, the 1999 currency attack on the Real and the Brazilian devaluation, the 2001 Turkey crisis, and the 1998–2002 Argentine great depression.

t_1 - initialization.

A. Downward phase of the CLIF cycles.[40]

The early 1990s were characterized by simultaneous recessions in the US, the European, and the Japanese economies. Several center countries experienced a very severe recession. This economic contraction in the center brought down the utilization rate of production capacity and the profitability of investment. The deteriorating conditions in the center triggered investment to the semi-periphery (Figure 3-7).

Stock prices and then real-estate prices in Japan sharply declined in the early 1990s. The subsequent slowdown in imports and the surge in exports meant that the

[40] The implications of the downward phase of the CLIF cycles and the pull factors are manifold for this period. Therefore, for the sake of conciseness, a more in-depth discussion is provided in the appendix (Subsection B.5).

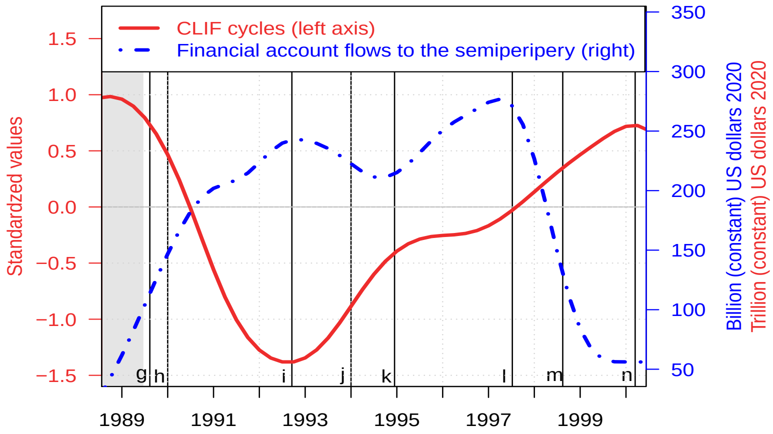


Figure 3-7: CLIF cycles and the semi-periphery's financial account during the second period

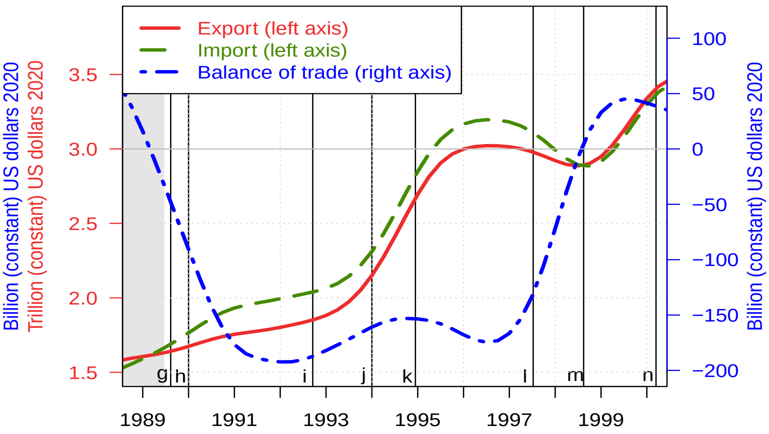


Figure 3-8: The semi-periphery's trade flows during the second period

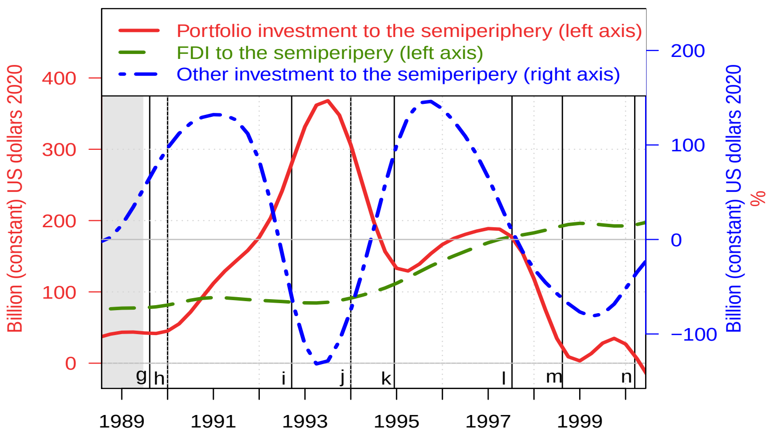


Figure 3-9: The semi-periphery's net financial flows during the second period (positive = net inflows)

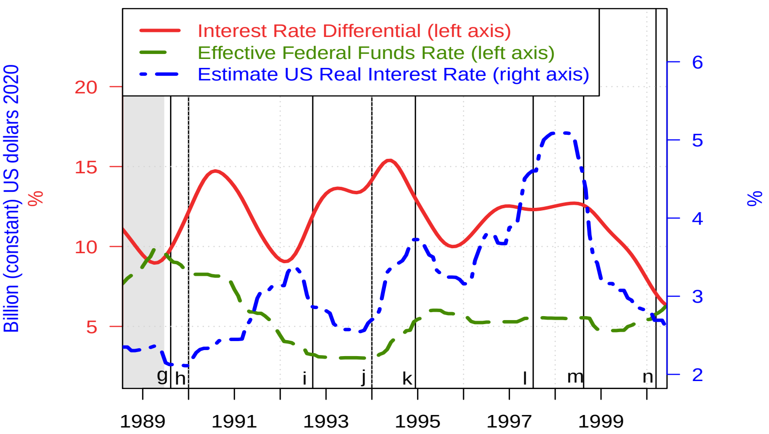


Figure 3-10: Real and nominal interest rates in the U.S. and interest differential during the second period

The top left chart exhibits an estimate of CLIF cycles and the financial account flows to the semi-periphery. The top right chart displays the exports and imports for the semi-periphery countries based on the IMF's Balance of Payments and International Investment Position dataset. The trade balance is the difference between the two variables and is positive when the exports exceed the imports. The bottom left chart shows the different financial inflow categories from the IMF's Balance of Payments and International Investment Position dataset for the semi-periphery. Other investments notably include bank loans. The bottom right chart indicates the effective Fed Funds rate, an estimate of the US real interest rate (the difference between the 10 Year treasury bill rate with the rate of inflation based on the GDP deflator). The chart also exhibits an estimate of the interest rate differential between center leader and semi-periphery countries (the difference in terms of median nominal interest rate between center leader and semi-periphery countries). In all chart, red and green lines (respectively blue lines) are associated with the left (resp. right) axis.

Some key disruptive dates and periods used in the text are respectively represented on these charts by vertical black lines and gray areas. In August 1989 the US Congress approved the Financial Institutions Reform, Recovery and Enforcement Act that instituted a number of reforms of the thrift industry and mark a turning point in the S&L crisis. This is referred by the line "g." The event "h" refers to the appointment of Yasuki Mieno as Governor of the Bank of Japan in December 1989 and the subsequent burst of the Japanese bubble. The event "i" points to the September 1992 currency attack on the Sterling. The NAFTA came into force on January 1, 1994, as indicated by the line "j." The event "k" is the December 1994 devaluation of the Mexican peso, key moment of the Tequila crisis. On July 2, 1997 the Thai government was forced to devalue and float the baht. It is referred by the event "l" and marks a crucial point of the Asian BOP crisis. The event "m" corresponds to the devaluation of the Russian ruble in August 1998. The last event, the line "n" refers to the beginning of the burst of the dot-com bubble (Nasdaq Composite stock market index) in February 2002. The first gray area represents the end of the first phase of the Saving and Loans crisis before the Financial Institutions Reform, Recovery and Enforcement Act.

Japanese trade surplus increased, which contributed to the higher prices of the yen, which became a handicap for export-oriented Japanese firms. This reinforced the efficiency-seeking FDI outflows from Japan to nearby semi-periphery countries that had started in the late 1980s. FDIs from Japanese firms attracted supplier firms and banks from Japan. The growth strategies of numerous semi-periphery East Asian countries were export-led, to insert in IPNs by hosting export platforms benefiting from the relatively low value of the domestic currency and wages.

The Savings and Loans crisis (1986-95) and Black Monday (the stock-market crash on October 19, 1987) led to a period of recession in the US. The Fed adopted an accommodating policy to fight the resulting credit crunch and the Fed funds rate plummeted from over 9 % in 1989 to less than 3 % in 1993 (Figure 3-10). The recession and lower rates triggered major transfers to Latin America and Asian countries. A notable example was Mexico, which began to prepare for membership in the NAFTA (signed in August 1992). At the same time, US pension funds and mutual funds increased their purchases of "emerging equities."

Many factors deteriorated the outlook of macroeconomic conditions in Europe. Not only did European exports to the US slow down, but the collapse of the USSR and the difficulties generated by the transition toward capitalism in the former Comecon economies generated a drastic reduction of consumption and investment that also affected Western European exports. Institutional changes in the EMS combined with the macroeconomic effects of German unification triggered major speculative attacks against EMS member states' currencies in 1992-93. Financial bubbles in Finland, Norway, and Sweden burst between 1991 and 1993, resulting in severe credit crunches and widespread bank insolvencies. These factors and the global recession elevated unemployment rates and discouraged productive investments in European center economies. These shocks drove financial investment out of Europe after 1993.

B. Major pull factors.

Many semi-periphery countries changed their economic strategies and adopted structural reforms, attracting FDI and generating export platforms to diversify their exports and improve their trade balance. These policies included tax changes, the creation of free-trade zones and export-processing zones with specific tax and labor law rules and the improvement of transport infrastructure with some heterogeneities. Likewise, the development of the Brady bonds in 1989-90 enabled many Latin American countries to convert impaired bank loans into long-term bonds partially guaranteed by the US government. This contributed to effectively ending the financial isolation of several semi-periphery countries from the global capital market.

The development of multilateral and bilateral trade agreements was also key. Accession to the WTO is also seen is a significant institutional change that strengthened the resilience of IPNs (e.g., Mexico in the late 1980s or Eastern Europe in the 1990s). Particularly effective were the provisions that protected better investors and intellectual property (e.g., from the 1994 Marrakesh Agreement).

Many semi-periphery countries (especially in Eastern Europe after the collapse of the USSR and in Latin America) were involved in extensive privatization activities in the 1990s, which attracted MNEs and investors based in center countries. Likewise, semi-periphery countries liberalized their capital markets to attract portfolio investment, facilitating access to international credit for domestic banks and for local governments. Several of them, including Thailand, Russia, and certain countries in Latin America, created new financial markets in the 1990s in line with the process of privatizations. The market capitalization of semi-periphery countries rose massively from 1988 to 1996. Portfolio investments surged around a few semi-periphery countries, and overall became much more important than bank loans (Figure 3-9). Another common domestic pull factor was the adoption of specific monetary policies in order to increase connections with the center's financial markets, such as pegging, the establishment of a currency board or the dollarization of the economy (e.g., the Argentina's Currency Board from 1991 to 2002), or reducing the inflation rate (e.g., Mexico). Moreover, large interest rate differentials existed between the center and the semi-periphery due to the high interest rates in some semi-periphery countries during the period, which encouraged carry trade investment by investors of center economies (see Figure 3-10).

t_2 - surge in inflows.

Overall, the reforms markedly increased both the opening of these economies and their attractiveness to international financial flows. As a result, they brought back FDI as an important source of financial flows from the center, largely overtaking ODAs in the mid-1990s. The GDP growth of these semi-periphery countries increased in response to increases in investment, and consumption spending followed from the increases in industrial productivity, as did the prices of real estate and stocks. Residents who sold their securities and assets to foreign investors from the center used the bulk of their receipts to buy other domestic securities and real estate. Many banks of semi-periphery countries used external sources of funding because they were much less costly than domestic sources.

The creation of export platforms attracting FDI flows in Mexico, in the ASEAN, and in Eastern Europe generated a diversification of export structures and a sudden rise of productivity in these semi-periphery economies. These phenomena were notably driven by the industrialization and the reallocation of underemployed labor from rural areas to the new export-oriented manufacturing areas, which implied a rising share of manufactured goods or tradable services. The macroeconomic situation was also characterized by a surge in the value of exports (Figure 3-8) and an accumulation of foreign exchange reserves (although this was small relative to the current period). These factors facilitated and accentuated the insertion of the relevant economies into IPNs and global financial markets (Hatch and Yamamura, 1996). This sometimes generated important spillovers in terms of management and technology know-how to local enterprises and workers. The expectation was that these countries would industrialize at a rapid rate, and corporate profits would surge.

This evolution became internationally perceptible in the early 1990s and was enshrined in many official publications.[41] Some semi-periphery countries were rechristened "*emerging markets*", after having been known as "developing countries" for several decades. Likewise, one major pull factor that preceded the wave of BOP crises was the creation of "*emerging market equities as a new asset class*" which triggered sharp increases in the purchases of these stocks by institutional investors headquartered in the US, the UK, and other center countries (Aliber and Kindleberger, 2017).

t_3 - unsustainability.

Based on official publications, overoptimistic anticipation of growth potential in "emerging" semi-periphery economies followed. This loosened international credit access and stimulated massive increase of financial inflows from the center that chiefly took the forms of short-term banks loans and portfolio investments in bonds. These flows were highly volatile and increasingly fed existing real-estate and financial bubbles as well as large government borrowing.

Many semi-periphery economies benefited from the effect of FDI-induced industrialization, which enabled them to exploit the pool of unqualified and underused labor from rural areas, and to increase of exports of manufactured goods and tradable services thanks to MNEs' outsourcing to local firms or by export platforms made by FDI. However, as pointed out by Krugman (1994), newly industrializing semi-periphery countries achieved a rapid growth in large part through an astonishing mobilization of resources, that is rapidly growing inputs (labor and capital) rather than through the gains of productivity. In most cases, local governments and economic actors could not shift the economy to a more intensive growth based on

[41] A major one is the "East Asian Miracle" report published by the World Bank in 1993 (an embellishing title for the economic performance of some East Asian semi-periphery countries). The reports from the IMF, EU, and the BERD on the economic transition of the Visegrád group economies also helped to build a positive image to FDI and portfolio investors.

the upgrading of domestic technological capacities. Thus, their productivity began to slow or stagnate (the "*middle-income trap*"), a phenomenon witnessed in many Eastern European countries, Asian semi-periphery countries, and in Mexico in the 1990s.

This middle-income trap was not directly visible to international portfolio investors, who anticipated the continuation of previous macroeconomic trends experienced by semi-periphery economies in the early industrialization growth stage. Pull factors that had increased attractiveness generated financial hot spots that concentrated the attention of international investors on a few specific countries, notably in East Asia, in Latin America, and Turkey. These countries attracted massive financial flows that generated real appreciation of the local currency, wealth effects, and higher domestic consumption, all of which helped to widen the trade and current account deficits, to create liquidity gluts, and to foster real-estate and financial bubbles. As for the debt crisis of the 1980s, most of these challenges were overlooked by international investors and institutions (Aglietta and Valla, 2017; Conti-Brown and Lastra, 2018).[42]

Few main factors of systemic risk followed a now familiar pattern: massive influx of foreign capital, a fixed exchange rate regime to the US dollar, etc. But few distinctive features characterized different sets of financial crises. A key example is that international interbank loans were the most dominant mode of transactions to

[42]Consider Mexico as an example. Its fixed exchange rate led to a rise of its REER and a drastic deterioration in competitiveness; the peso depreciated by 5.4 % against the dollar from the early 1991 to the end of 1993, while the general level of prices increased by around 30 % compared to American prices during the same period. Concurrently, credit growth caused a collapse in private savings, the rate of which fell from 16 % to 9 % between 1989 and 1993. The real appreciation of the peso and the booming domestic demand explain that Mexico's current account deficit increased from 3 % to 8 % of GDP before the crisis. Yet it is worth mentioning that Mexico federal budget were brought back into balance and that its foreign exchange reserve was multiplied by around a factor 4.5 from the end of 1989 to February 1994, leading the IMF to approve Mexico's economic policy in the spring of 1994. Likewise, the risk premium of the tesobonos (Mexican dollar-denominated Treasury bonds) over US Treasury bills was only 2 % in early December, a extremely low level. After the crisis, this premium increased to reach around 20 % in February 1995. For the case of East Asian countries, we can concisely notice that the confidence in the impressive growth was so great that the early-warning signs for forthcoming problems were largely ignored, like the bankruptcy of speculative actors in Thailand in January 1997 and the difficulties of some South Korean chaebols in June 1997.

the East Asian economies while portfolio investment were more dominant in Latin America.[43] In East Asia, carry trade investments were more commonly reported and local banks played a preponderant role in the expansion of credit. [44] We can see on Figure 3-9 that portfolio flows to the semi-periphery considerably plunged between in 1994 while other investments (including loans) rose abruptly between 1994 and 1996. Figure 3-7 indicates that this resulted from changes in the modalities and locations of the investments from the center (within the semi-periphery) rather than a substantial change in the allocation of investment between the center and the semi-periphery as a whole.

t_4 - crash.

Eventually, when the developments of macroeconomic fundamentals highlighted the unsustainability of such overoptimistic anticipation, and in particular when financial markets realized the risk linked to rising debt and the degradation of the cumulative trade balance (Figure 3-8), international investors lowered their expectation of profits and, increased the anticipation of loan delinquency rates and currency devaluations. Many semi-periphery host economies suffered brutal capital outflows (Figure 3-9), lost access to international credit, and experienced the burst of real-estate and financial bubbles followed by painful adjustment processes.

In the context of large unsustainable macroeconomic dynamics, an international or domestic push factor could trigger a BOP crisis. The first catalyst was slow growth and political instability (a major domestic push factor) in Mexico in late

[43]Yet portfolio investment also played a macroeconomic role in East Asia and the devaluation of the Thai baht is concomitant with a plummet in portfolio investment to the semi-periphery. Moreover, Hong Kong was an exception in East Asia at the time and portfolio investments were much more important for this country.

[44]International banks mainly lent to local banks in dollars and yen. They also lent directly to local businesses, particularly in Indonesia.

1994 (Lustig, 2000).[45] Investors moved their capital away.[46] Subsequently these events created a contagion effect that had repercussions in terms of negative expectations among investors of the center towards many semi-periphery countries. Three dynamics should be highlighted. Firstly, portfolio investors of the center amalgamated in semi-periphery countries according to their geographic proximity. The BOP crisis in Mexico in 1994 (resp. in East Asia in 1997-98) prompted capital to flow out of other Latin American (resp. Asian) semi-periphery countries (due to the contagion effect). In some cases, this effect triggered large financial distress in semi-periphery countries with healthy macroeconomic characteristics almost by itself, as in Argentina in 1994 or South Korea in 1997. Secondly, when investors repatriated their capital from one region, they reallocated their funds to semi-periphery countries in other regions. For instance, between 1994-95 and 1996-97, investors of the center shifted their investments from Latin America to Asia. Thirdly, while currency pegs were an interesting characteristic for attracting FDIs and facilitating integration in IPNs, when anticipation of devaluation rose, even more capital flowed out through fear of a massive and abrupt change in currency value, and in doing so increased the likelihood of such changes. Overall, the semi-periphery experienced large and disruptive financial outflows that caused serious financial stress from 1994 to 2002 in Latin America, East Asia, Russia, and Turkey (e.g., see Yalman et al.,

[45] For East Asian countries, the two main temporal references for the start of the crisis are the devaluation of the Thai bath on July 2, 1997 and the attack against the currency board of Hong Kong on October 20, 1997. In Russia, Moscow devalued the ruble and declared a ninety-day moratorium on the payment of foreign debts owed by Russian banks on August 17, 1998. For the second phase in Latin America, Brazil devalued in January 1999. We can date the beginning of the Argentine crisis either by the beginning of the Argentine Great Depression which began in the third quarter of 1998 or the large rise in the spreads of the Argentinian debts in March 2001. A additional major event was the end of the currency board in Argentina December 2001. Turkey became one of the last semi-periphery economies to experience a devastating crisis, characterized by the ending of its soft exchange rate peg to the US dollar in February 2001.

[46] Concerns about the Mexican peso led private investors with a short position on the dollar against the peso to reduce their position by buying dollars massively. Likewise, the reduction of the foreign exchange reserves triggered a lost of confidence in stability of the foreign exchange rate. Speculation against the peso became general, caused a disruption of the exchange rate, prompted a even more larger withdrawal of capital from non-residents and a flight of residents from their currency. Foreign exchange reserves reduced by around a factor 4.5 and the exchange rate devalued by more than 100 %. Interest rates soared, the stock market crashed, inflation accelerated to an annual rate of around 50 %. The burden of external debt rose back to 1982 levels, with very short repayment terms.

2018; Lustig, 2000; Calvo and Talvi, 2008; Barro, 2001).[47]

t_5 - aftermath.

The direct effect of these outflows was the sharp decline in the price of the Mexican peso, which resulted in a sudden shift in the Mexican trade balance from a deficit of USD 20 billion in 1994 to a surplus of USD 7 billion the next year. Similarly, when property prices and stock prices in Thailand and its neighbors fell sharply in the summer of 1997, the prices of their currencies declined and their trade deficits morphed into trade surpluses. The same happened to Russia, Brazil, Argentina, and Turkey and to the semi-periphery as a whole (Figure 3-8). As a counterpart, there came a surge in investment inflows to the US which contributed to an increase in the US trade deficit and to the upward phase of the CLIF cycle (mainly in the US).

An effect of the numerous financial crises experienced by emerging economies in the 1990s was the adoption of policies securing a substantial reserve of foreign exchange to avoid future speculative attacks on their currencies or conditional bail-outs (e.g., 1997 Asian crisis). This was facilitated by the rise in the commodity prices on global markets from 2001 onwards, partially caused by rising demand (Stuermer, 2018). Numerous semi-periphery economies accumulated foreign exchange reserves and a large proportion of these funds were invested abroad, notably in US financial markets.

3.3.3 The third period: 2000-2019

The triggering of the third wave of BOP crises in semi-periphery countries spanned from the direct consequences of the GFC and the ending of the commodity boom to the

[47] We can additionally note that massive rescue plans were implemented to avoid even more disruption and defaults and SAPs led by the IMF were implemented. For the case of Mexico, USD 50 billion were provided to avoid a default. Bringing USD 18 billion itself, the IMF conditioned its aid with a drastic stabilization plan which reduced the GDP by 7 % in 1995. For details on rescue plans and the role of the IMF during the 1990s, see Boughton (2012). In addition, Conti-Brown and Lastra (2018) provides useful details on the cooperation during the Asian financial crisis and its aftermath.

taper tantrum of 2013, the repercussions of the Chinese economic slowdown, and the return to higher profitability conditions in the center. The GFC caused an enormous volume effect. For this reason, we start by concisely going through the direct impacts of the GFC on some semi-periphery economies. Then, we use the model developed in Subsection 3.2.3 to unfold an analysis of the countercyclical crises in the semi-periphery of the 2010s.

The volume effect caused by the GFC. The dot-com bubble burst in 2000 and the US economy experienced serious overcapacities. Yet macroeconomic imbalances were not fully corrected in 2001 because capital flowed into new bubbles and perpetuated the upward phase of the financial cycles of center economies (Figure 3-11). Institutional changes in the mortgage and real-estate markets in the early 2000s combined with accommodating monetary policies in the center generated several large real-estate bubbles (Rajan, 2011) and lowered real and nominal interest rates (Figure 3-14). Financial innovations generated new injections of liquidity that accelerated real estate and financial bubbles.

During this upward phase of CLIF cycles, investment opportunities remained high in center economies (Figure 3-11). Nevertheless, some semi-periphery economies attracted substantial financial flows (due to the volume effect), particularly in Europe.[48] FDI flows were encouraged by institutional reforms such as privatizations and regional integration schemes. Governments from countries that had experienced macroeconomic stress devaluated their currencies to restore their trade balances from 1997 to 2000. Additionally, international commodity prices began to rise in the early 2000s. The semi-periphery's trade balance was large and positive (Figure 3-12). These pull factors accentuated the attractiveness of the semi-periphery.

The downturn of the real-estate market in the US triggered a very detrimental and global financial crisis (see Figure 3-11). The GFC generated a major deterioration of the balance sheet of banks, leading to a drying-up of the interbank loans markets and a

[48]These flows took the form of loans to the public sector (e.g., Greece, Portugal, Hungary) and to households or enterprises (e.g. Hungary, Romania, Baltic countries, Mexico).

search for liquidity. International banks repatriated liquidity from the semi-periphery and periphery, prompting capital outflows away from these areas. These elements created an enormous adverse volume effect (incorporating withdrawals and repatriations of capital, the drying up of the international interbank market and international liquidity, the fall in imports from the center, etc.). Therefore, in the late 2000s, the economic expansion of almost all semi-periphery countries were gripped by financial and trade difficulties and several semi-periphery economies plunged into large recessions and financial crises.

Due to a deeper integration with the EU and the eurozone, semi-periphery economies from Eastern and Southern Europe had received important financial flows from Western European investors. These inflows suddenly ceased after 2008 and these countries were among the most affected by the immediate effects of the crisis. The October 2008 IMF Hungarian rescue package was followed by many other programs. By 2009, those economies from the European semi-periphery found themselves facing a debt and BOP crisis that required the support of the EU and/or the IMF. Many Latin American countries were also in the throes of major financial difficulties.[49] These constituted substantial push factors for investors, accentuating the financial flows out of the semi-periphery. The difficulties of the European semi-periphery lasted. In September 2011, based on the Five-Year CDS spread, the countries most likely to default were all in the Eurozone (Greece, Ireland and Portugal) - riskier than Belarus, Venezuela, Pakistan, Argentina and Ecuador. Due to their considerable integration with the US economy, South Korea and Mexico were also strongly hit. Likewise, Turkey's and Russia's GDP fell sharply in the direct aftermath of the 2008 events.[50]

[49]Hungary, Iceland, Latvia, Pakistan, Georgia and Ukraine were among the first countries to adopt IMF programs in late 2008. In 2009, IMF programs were approved for Armenia, Belarus, Mongolia, Serbia, Bosnia & Herzegovina and Romania. Precautionary programs were put in place for Costa Rica, El Salvador, Guatemala, and Serbia. Mexico, Poland, and Colombia benefited from the new IMF's Flexible Credit Lines. (see IMF, 2009, for more details).

[50]This section aims at providing empirical evidence confirming Propositions 3.1 and 3.2. Therefore, for the sake of conciseness, a more detailed analysis of the volume effect and the direct effect of the GFC is reported in the online appendix (Subsection B.5.1).

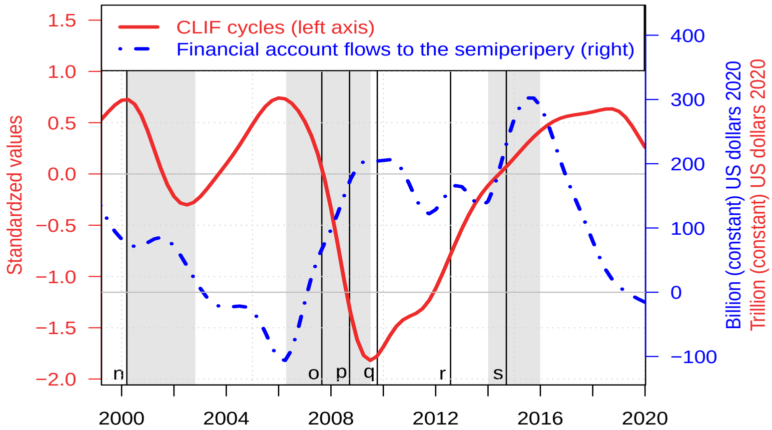


Figure 3-11: CLIF cycles and the semi-periphery's financial account during the third period

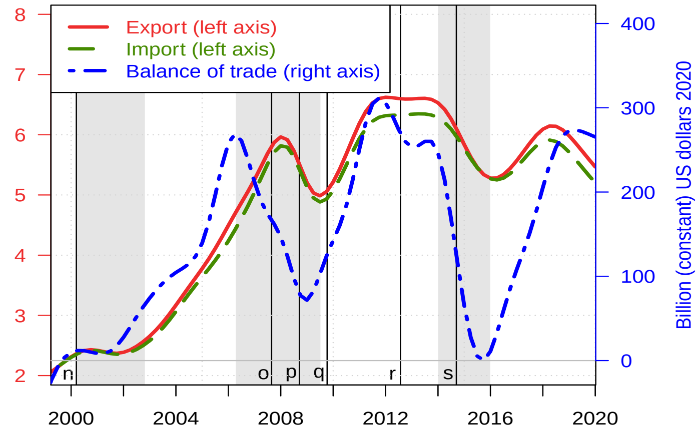


Figure 3-12: The semi-periphery's trade flows during the third period

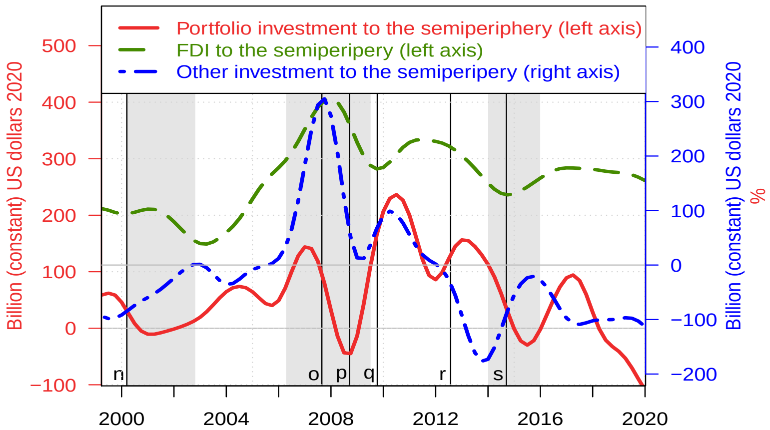


Figure 3-13: The semi-periphery's net financial flows during the third period (positive = net inflows)

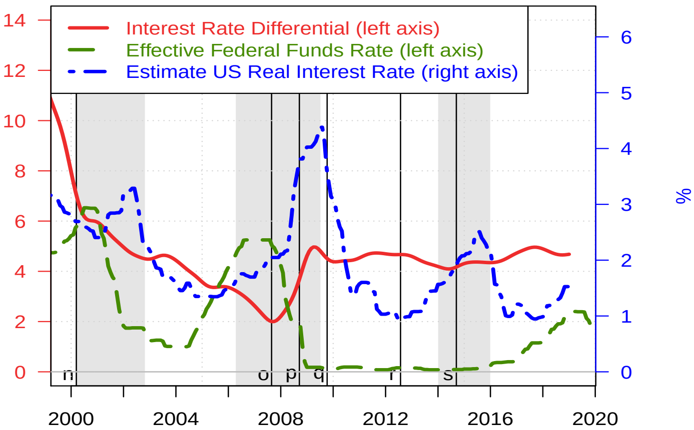


Figure 3-14: Real and nominal interest rates in the U.S. and interest differential during the third period

The top left chart exhibits an estimate of CLIF cycles and the financial account flows to the semi-periphery. The top right chart displays the exports and imports for the semi-periphery countries based on the IMF's Balance of Payments and International Investment Position dataset. The trade balance is the difference between the two variables and is positive when the exports exceed the imports. The bottom left chart shows the different financial inflow categories from the IMF's Balance of Payments and International Investment Position dataset for the semi-periphery. Other investments notably include bank loans. The bottom right chart indicates the effective Fed Funds rate, an estimate of the US real interest rate (the difference between the 10 Year treasury bill rate with the rate of inflation based on the GDP deflator). The chart also exhibits an estimate of the interest rate differential between center leader and semi-periphery countries (the difference in terms of median nominal interest rate between center leader and semi-periphery countries). In all chart, red and green lines (respectively blue lines) are associated with the left (resp. right) axis.

Some key dates and periods used in the text are respectively represented on these charts by vertical black lines and gray areas. The event "n" refers to the beginning of the burst of the dot-com bubble (Nasdaq Composite stock market index) in February 2000. The event "o" indicates the runs on Countrywide Financial and Northern Rock in mid-August 2007. The Lehman Brothers' bankruptcy in 15 sept 2008 is exhibited by the line "p." George Papandreou became Greece's prime minister in October 4, 2009 as indicated by the event "q." Soon after the Greece crisis and European sovereign crisis begun. The event "r" represents the moment when the governor of the ECB, Mario Draghi, made the now famous "whatever it takes" speech in London on July 26, 2012 and marks a turning point in the European crisis. The event "s" corresponds to the beginning of the oil price plunge in July 2014. The first gray area represents the burst of the dot-com bubble, namely the period of decline in the Nasdaq Composite stock market index between March 2000 and October 2002. The second gray indicates the 2007-2009 GFC, that is the period during which the CLIF cycles are sharply declining. The third area exhibits the period of decline in Chinese imports.

From the GFC to repercussions of China's slowdown and the taper tantrum. The third wave of BOP crises in the semi-periphery continued after the GFC following a pattern similar to those of the two first waves (see Subsections 3.2.3, 3.3.1, and 3.3.2). The second phase was triggered by a few international push factors; the ending of the commodity boom, the repercussions of China's economic slowdown around 2012-2016, the plunge in oil prices, the taper tantrum around 2013, etc.

t_1 - initialization.

A. Downward phase of the CLIF cycles.

Governments and central banks were swift to launch interventionist policies. Governments of center economies organized a massive bailing-out of banks (in particular in the US and the UK). On the fiscal front, several governments (notably the US, China, Japan, and Germany) launched exceptionally large stimulus packages (Tooze, 2018; Defraigne and Nouveau, 2021). On the monetary front, central banks innovated by designing new instruments to provide the necessary liquidity to banks and private companies (e.g., see Rajan, 2011), while many interest rates were lowered close to the zero-lower bound (Figure 3-14).

The global injection of liquidity was unprecedented since the industrial revolution in peacetime; the balance sheets of central banks from center economies increased fourfold in a decade. These accommodating policies enabled banks to stabilize their situation, resuming lending activities. It also generated a greater liquidity glut once banks had cleared a large part of their toxic assets and non-performing loans from their balance sheets.[51] The stabilization of banks from the center and the liquidity glut generated exceptionally low levels of interest rates, fostering a rising level of total debt across the global economy. Central banks of the center tried to maintain interest rates low in their economies through accommodating monetary policies, and in particular their bond-purchasing programs. These policies

[51] The financial sector was partly stabilized by the spring of 2009, but the effects of the deleveraging and the credit crunch were strongly felt in center economies until the mid 2010s.

incentivized financial investors to shift their investment out of the bond markets and to increase their funding to more profitable investment. The purpose was also to decrease the interest rates in higher-risk assets. This contributed to push investors to search for higher yields in the semi-periphery. Moreover, this effect pushed up the differential between the short-term interest rates paid in the center and the semi-periphery, and stimulated carry trade investments into some of the non-European semi-periphery (Figure 3-14).

The aftermath of the GFC was marked by the context of falling returns for investment in productive capacities in the center, notably in the construction sector but also in tourism, car and steel industry, etc.[52] The adverse wealth effects in center economies pushed down the demand for many products and then depreciated the returns on these local markets. These conditions elevated the financial attractiveness of the semi-periphery and financial flows moved to semi-periphery and even periphery economies (Figure 3-11). Likewise, as soon as the downturn in US real-estate markets was felt, major investment banks, rating agencies, and consultancy firms began to promote the opportunities provided by markets for commodities but also by "*frontier markets*,"[53] economies that were considered as potentially shifting from "least developed" to "emerging."[54]

B. Major pull factors.

The above-mentioned domestic pull factors of the semi-periphery persisted and increased the attractiveness of some semi-periphery countries. These included cur-

[52]Several semi-periphery also suffered from overcapacity in some industries. The steel industry in China is a well-known example.

[53]This designation originated in the 1990s, when Standard and Poor's (S&P) started to track an aggregate index of frontier markets. The term became prominent in 2007 when S&P launched its Select and Extended Frontier Indexes. MSCI launched its own Frontier Markets Index late in 2007, and frontier market mutual funds and ETFs emerged during this post-GFC period. For more details, see publications from S&P, MSCI, Mc Kinsey, and Deutsche Bank from 2007-12. A week before the collapse of Lehman Brothers, the *Financial Times* wrote an article titled "*Pre-emerging economies grow increasingly attractive*" (September 7, 2008). With a certain lag, even scientific publications were promoting frontier markets (e.g., Berger et al., 2011, argue that these economies "*offer significant diversification benefits*".).

[54]In the financial sector, it is worth mentioning that the fall of stock markets in center economies ended with the financial stabilization of 2009 and generated financial opportunities that rapidly attracted financial flows back in financial markets of the center.

rency devaluations after the second wave of BOP crises or after the outbreak of the GFC, institutional reforms, trade agreements, and the accumulation of reserves by central banks (Caupin, 2014; Conti-Brown and Lastra, 2018). In contrast to the close semi-periphery of the EU, several semi-periphery economies (e.g., Latin America, Turkey) which had received fewer flows in the preceding years (2000-08) continued to benefit from good growth and a strong export surplus (Figure 3-12) partially driven by commodity exports to China, undercapacities in some industries, the preparedness of central banks to manage large financial shocks and a steady demand from some other "emerging" economies (Chaponnière and Lautier, 2012; Jenkins, 2019; Conti-Brown and Lastra, 2018).

With better macroeconomic fundamentals resulting from the policies implemented in the 2000s, several semi-periphery countries implemented countercyclical monetary and budgetary policies, to fight against the global low growth environment. The resulting net growth differential between center and semi-periphery countries, partly attributable to these countercyclical policies was a notable pull factor (Caupin, 2014). For example, Conti-Brown and Lastra (2018) noted that Brazil, Chile, Colombia, Mexico and Peru had strong macro-financial fundamentals and put in place buffer mechanisms over several years, enabling them to handle the impact of the GFC. Several central banks in the semi-periphery dealt well with the reversal of capital flows and contributed, to a large extent, to stemming deflationary pressures. These stronger fundamentals attracted substantial financial flows from the center to Latin America in the form of portfolio investments (Figure 3-13) but also foreign exchange operations, loans, and real-estate investments.

The commodity prices started to rise in 2001 and continued for around 10 years. This was interrupted in 2009 as a result of the global financial crisis but resumed quickly in 2010 and 2011. After 2011 commodity prices fell significantly. Yet in 2015, they remained higher in real terms than they were at the end of the 1990s. This was partially due to the rising and steadfast demand from the industrializing semi-periphery economies of East Asia, notably China (which continued to experience a high growth from 2009 to 2011 thanks to a massive stimulus package), and it accentuated the attractiveness of commodity exporters in the semi-periphery. The rising commodity prices in the aftermath of the GFC was a major international pull factors.

Financial flows to the semi-periphery were also encouraged by the better integration of those countries into the global economy with the development of supply chains at regional and international levels, in the context of lower transport and communication costs. In additional, the general improvement in the institutional fundamentals of semi-periphery countries (e.g., the increasing the autonomy of central banks, better budgetary discipline and strengthening the sustainability of public and external debts) reassured investors on the international markets.[55]

t_2 - surge in inflows.

The macroeconomic situation of many semi-periphery countries was encouraging due to the combination of capital inflows, favorable international commodity prices, and other pull factors. International investors from the center increased their stake in equity and bonds from the semi-periphery by around 50 % between 2008 and 2014 (IMF, 2015a). This relatively favorable macroeconomic environment and the liquidity glut generated by the accommodating monetary policy of center economies generated the possibility of access to international loans for governments and businesses from the semi-periphery. From the viewpoint of the yield-chasing international investor, assuming the dollar did not abruptly appreciate before the due date, it would be a profitable carry trade. According to Miyajima and Shim (2014), the

[55] We can add that the aftermath of the GFC was also a period of intense domestic competition and overcapacity in several industries in China, including steel, cement, flat glass, aluminium, leather, and textiles. This led private MNEs and SOEs to seek new markets abroad (particularly in mature industries such as textiles and garments, footwear, bicycles, and electrical appliances). Financial investments to other semi-periphery countries and exports of underutilized plants and equipments rose notably. Overall, the role of China should not be overstated. The online appendix (subsection B.5.2) provides more details on the influence of China on other semi-periphery during the period, and notably on the commodity boom and the role of Chinese's overcapacity. See also Jenkins (2019) for an in-depth discussion on China's influence on Latin America and Sub-Saharan Africa.

withdrawal of portfolio investments that caused the financial distress in the semi-periphery as a consequence of the GFC amounted to around USD 246 billion in 2008. In contrast, the portfolio inflows that morphed the economic hardship into a much better outlook was substantially larger, with around USD 368 billion for 2012 alone.

The growth expectations of the semi-periphery by international investors were also high. This was based on good macroeconomic fundamentals. From 2010 onward, numerous semi-periphery countries started to grow again while inflation was kept under control - partially viewed as the fruitful and natural outcome of rising central bank independence and financial development in these countries over the last decades. Because of easy monetary conditions provided in the center and low returns in these financial and securities markets, investors from the center turned to semi-periphery countries to invest in search for higher yields (for Latin America, see Conti-Brown and Lastra, 2018). The large financial inflows received by semi-periphery economies and higher international commodity prices helped speed up GDP growth. These macroeconomic performances were also the result of decade-long improvement of the terms of trade of many semi-periphery and periphery countries.[56]

In contrast to the overoptimistic economic forecasts of the 1970s, the period was not marked by great economic illusions. Numerous officials in the semi-periphery were well aware of the difficulties ahead; large capital inflows were putting upward

[56] More specifically, between 2002 and 2011, fuel-exporting countries (e.g., Bolivia, Colombia, Ecuador, Venezuela, Angola) saw the greatest improvement in their terms of trade. The close second group was mineral exporters (e.g., Chile, Peru, many Sub-Saharan African countries). Argentina and Brazil, which export a range of commodity products (fuels, minerals, agricultural products) and some manufactures, also saw their terms of trade improve during the period. The third group was made up mainly of agricultural exporters and saw little overall change in the terms of trade over the period. Yet, some semiperiphery countries experienced a fall in their terms of trade - in particular those specialized in manufactured exports (e.g., Costa Rica, the Dominican Republic, El Salvador, Mauritius, Lesotho, Madagascar). Although demand from China is certainly not the only factor affecting the terms of trade of those countries, it is quite clear that countries which have experienced improvements in their terms of trade have tended to produce commodities that China demanded, while those specialised in manufactured goods (competing with China) or commodity goods where China had a very limited impact (e.g., tropical products) experienced a degradation of their terms of trade. See online appendix (Subsection B.5.2 for more details on the role of China.

pressure on semi-periphery currencies and inflation rates, and fueled credit expansion, all feeding financial vulnerabilities. Lessons were learned from past financial crises and governments in numerous semi-periphery economies complained about the inflows of “hot money” from the center (e.g., at the G20 meeting in November 2010 in Seoul) and took serious measures to limit them by restricting capital inflows on the financial markets.[57] Furthermore, the pre-GFC consumption boom in center economies and the commodity boom of the 2000s enabled numerous semi-periphery economies to accumulate large foreign exchange reserves.[58]

***t_3* - unsustainability.**

A few rising and intertwined economic and financial vulnerabilities characterized the growth models of the semi-periphery around the mid-2010s. Firstly, the size of the public and private debt was climbing. Secondly, the form of the debt was troubling; particularly massive in energy companies, high debt-rollover risks, a large share denominated in US dollar (particularly for private companies), and a rising share of portfolio relative to FDI flows since the GFC. Thirdly, the appreciation of some semi-periphery countries’ REER was raising concerns about Dutch Disease and prospects of devaluation. Fourthly, the balance of trade of many semi-periphery economies was relying more and more on commodity prices, with some semi-periphery countries experiencing a “recommodification” of their economies (e.g., in Latin America). Fifthly, the slowdown in growth in several large semi-periphery countries (including China) was relatively predictable as the effect of countercyclical policies (inherently unsustainable over the medium term) had started to fade. Sixthly, the interest rates were very low due to the considerable injection of liquidity by central banks from the center - first and foremost the Fed. In the context of rising macroeconomic

[57]For example, central banks in Brazil, Colombia, Peru, South Korea, Thailand, Indonesia introduced or tightened capital flow management and/or macro-prudential policies to curb speculative capital inflows, limit the appreciation of their currencies, and prevent excessive credit growth (Conti-Brown and Lastra, 2018; Tooze, 2018).

[58]This is also viewed as a reaction to the financial crises of the previous decades and for “mercantilist” purposes. See Cabezas and De Gregorio (2019) for more details.

performances in the US, this pushed up demand for tapering, and then a rise on international markets' interest rates.

Public debt and large enterprises' debt increased massively in semi-periphery economies in 2010-14 (Caupin, 2014).[59] By mid-2015, governments and private companies from the semi-periphery piled up at least USD 3.3 trillion of dollar-denominated debts (McCauley et al., 2015). The "frontier markets" played a rising role.[60]

In addition, from 2007 to 2014, the debt, most of which in the nonfinancial private sector, "grew faster than GDP in all major emerging market economies," and "a significant portion is in foreign currencies", in particular in Chile, Poland, Turkey, Russia, South Africa, Indonesia, Brazil and India (IMF, 2015b). Likewise, since 2007 the share of foreign currency government debt (as well as nonresident holdings of local currency general government debt) rose in many semi-periphery countries (Indonesia, Mexico, Poland, Romania, and South Africa) or remains high (Hungary).[61] Significantly, between 2007 and 2015, energy companies issued around a third of all hard-currency nonfinancial corporate bonds of semi-periphery countries, benefiting from favorable financial conditions to expand their operations, with the belief that the trends would continue (IMF, 2015b). In the 2010s, because these energy sec-

[59] A known and symbolic example is the bond issue by Petrobas in May 2013. The Brazil's oil SOE raised USD 11 billion in ten-year bonds. It was the largest bond issue by company from a semi-periphery economy. The demand was considerable and the yield was as little as 4.35 %, less than numerous sovereign borrowers (see "The Dollar's Strength Is a Problem for the World," Economist, December 3, 2016).

[60] For example, Zambia issued its first dollar-denominated bond in September 2012. It was a huge success. The offering of USD 750 million attracted more than USD 11 billion in bids, for a yield of "only" 5.6 % ("Zambia Raises $750 mln in Debut 10-Year Eurobond," *Reuters*, September 13, 2012). In 2014, Zambia issue raised USD 1 billion through an international bond sale, with a yield of 8.625 % on the 10-year dollar-denominated bonds. This was "slightly below the guidance of bankers, indicating that investors retain a healthy appetite for high yields from frontier markets" ("Zambia Makes Bond Market Return," *Financial Times*, April 7, 2014). Yet, the country's borrowing costs rose sharply since 2012. The same source indicates that in 2013 deals from countries including Gabon, Tanzania and Rwanda enabled Africa to issue a record USD 11 billion in sovereign bonds (up from USD 6 billion in 2012). Yet it is worth remaining that overall these "frontier markets" were still modest in magnitude relative to the more advanced and larger semi-periphery economies.

[61] Yet this must be nuanced given the parallel developments of local currency bond markets for several semi-periphery countries during the period, particularly those with low inflation, stronger institutions, and well defined creditor rights (Burger et al., 2015). According to Caupin (2014), the total debt (public and private) of emerging countries issued in local currency increased from USD 4,900 to 9,100 billion between the end of 2008 and the end of 2012.

tors accounted for around half of investment in large semi-periphery economies on average, this also affected longer-term growth for other sectors.[62]

The share of international investors in local bond markets of the semi-periphery increased and created a rising debt-rollover risk.[63] This global interest in portfolio assets from the semi-periphery exposed them to serious risks. As the IMF pointed out, given that the top 500 asset management companies had more than USD 70 trillion in their portfolios, only a 1 % reallocation of these funds to the center would have implied outflows from the semi-periphery of USD 700 billion. This was enough to create a huge financial stress as it represented around twice the portfolio inflows to the emerging markets in 2012 (Miyajima and Shim, 2014).

A large part of the growth models followed by several semi-periphery countries was based on continuing demand and high price for commodities. Many commodity-exporters (notably South Africa, Brazil, Indonesia, India and Chile) experienced a significant appreciation of the REER between 2001 and 2012. Almost all oil net-exporter semi-periphery and periphery countries also saw their REERs appreciate over the period of the commodity boom (Darvas, 2021). Likewise, it has been argued that several of those economies started to suffer from Dutch Disease (Jenkins, 2019). This concerned countries like Angola, South Africa, Indonesia and Brazil. The share of commodity sectors in GDP rose substantially during the period for many semi-periphery countries. Together these dynamics highlighted that these countries were likely to endure downward pressures on their currencies in the coming years and that their exports and the GDP were relying more and more on commodities, so more vulnerability to international conditions.

In the meantime, many forces had begun to pressure down the prices of many

[62] We can note that the deterioration of balance sheet (return on assets, leverage, and debt-servicing capacity) for the energy sectors in several semi-periphery countries started before the oil price started declining.

[63] This is because when local currencies are under pressure and domestic assets are sold off, international investors reduce their exposure and are likely to not roll over maturing debts (De Bock et al., 2020). It was called the "original sin 2.0" in IMF (2015b) and the "original sin redux" in "Emerging markets aren't out of the woods yet" (15 March 2019), *Foreign Affairs* by Carstens and Shin.

commodities (Jenkins, 2019; Trostle, 2010). There was a substantial increase in the supply of several metals due to the earlier increase in investments in new mines made during the boom (IMF, 2015b). Several supply-side factors deteriorated the prices of oil and gas, notably the OPEC's decision to stop trying to keep the price of oil high and the increase of production in both hydrocarbons from unconventional sources (shale and tar sands) in North America. In addition, decline in oil prices impacted the price of agricultural commodities; by reducing the cost of inputs, and by freeing up arable land (previously used to produce biofuels, which have become a less attractive alternative compared to other crops). Overall, the commodity boom ended around 2011 and squeezed the exports of several semi-periphery countries.

Moreover, the macroeconomic effects of countercyclical measures implemented by numerous semi-periphery countries after the GFC had started to diminish. Notably, in 2012, the stimulus launched by the Chinese government came to an end and generated a slowdown of the economy with numerous Chinese industries facing overcapacity.[64] This contributed to a decrease in demand for several major commodities and pressured down prices of some low-tech manufactured goods and services (e.g., clothing, construction), because the rising international competition accentuated by Chinese companies searching for new markets abroad.[65] More broadly, the global economic slowdown between 2012-16 generated a drop in real commodity prices (Kilian and Zhou, 2018) and a plunge in semi-periphery exports (Figure 3-12).

[64] There were two main ways in which China's huge growth could have contributed to greater financial instability in semi-periphery economies. Firstly, China's economic slowdown accentuated the downturn in commodity prices after 2011 (e.g., iron ore, timber, oil). Yet China imports continued to rise after 2011 and other factors explain the end of the commodity boom. Secondly, the growth of China might have caused some semi-periphery countries to experience a 'recommodification' or 'premature deindustrialization' of their economies (Rodrik, 2016; Palma, 2011), become more specialized in commodity exports and more vulnerable to price fluctuations. For example, Jenkins (2019) argues that manufacturing production in South Africa was 5 % lower in 2010 than it would have been without the rising influence of China. However, the dependence of many semi-periphery economies on commodity exports unquestionably predates the rise of trade with China and characterizes trade relations with the EU and US as well. See online appendix (Subsection B.5.2) for more details.

[65] At the same time, the EU was still suffering from the deleveraging process and from the inherent contradictions of the Eurozone, which threatened to burst into another financial meltdown (Pisani-Ferry, 2011; Bastasin, 2012). This also contributed to decline the global demand for many products.

t_4 - crash.

Against this general backdrop, the beginning of normalization of the Fed's monetary policy, the economic slowdown in the majority of large semi-periphery countries (notably in Asia) once the effect of countercyclical policies had faded, and the supply-side effects pressuring down commodity prices led international investors to abruptly reassess their risks and put an end to the cycle of large inflows to the semi-periphery. The combination of these factors quickly deteriorated the macroeconomic situation in several semi-periphery countries. This particularly impacted those that had not experienced major financial difficulties after the GFC, those that had attracted the largest foreign inflows – which were also those with the most solid financial records (Eichengreen and Gupta, 2014) –, and those relying strongly on commodity exports, notably in Latin America (Wise, 2016).

The announcement of a possible tapering by the Fed in May 2013 was enough to provoke a violent reaction. On June 2013, the Fed made a more specific announcement and triggered a considerable "taper tantrum".[66] In a few days short-term yields surged (almost 25 %), and resulted in a rise in US long rates and by capital outflows from semi-periphery countries as Western investors pulled their money (Miyajima and Shim, 2014), attracted by higher and rising yields on the US market and anticipating a lasting reduction in international liquidity. These tensions led to sharp depreciations of certain currencies of the semi-periphery,[67] widened the risk premiums on external debt, increased the interest rates and bond yields in local currency.[68]

A second period of financial tensions in the semi-periphery started in January 2014. It was triggered by three main factors (Caupin, 2014); (a) the confirmation of the

[66]Conditional on continued positive economic improvements, the FOMC would scale back its monthly bond purchases by around 25 % at the policy meeting of September 2013 and the bond-buying program might end entirely by mid-2014.

[67]For example, currencies of South Africa, Brazil, Turkey, Indonesia, and India lost between 12 and 22 % of their values from May to September 2013.

[68]Although capital control policies implemented to curb excessive inflows (and the reversal outflows) did not prevent foreign money from leaving, they seemed to have limited the scale of the damage.

start of normalization of US monetary policy, (b) political concerns in Ukraine and Turkey as well as uncertainties due to elections in several major semi-periphery countries in 2014, and (c) rising fears about the extent of the Chinese economic slowdown and its impacts.[69] To limit capital outflows and relax tensions on the foreign exchange market, which had resulted in numerous depreciations and significant drops in foreign exchange reserves within the semi-periphery, central banks of several semi-periphery countries continued to raise their monetary policy interest rates (with the notable exception of Mexico). Yet the high volatility in the exchange rate markets of many currencies and the appreciation of the dollar continued.

The US dollar appreciated substantially; reflecting downward pressures on currencies of the semi-periphery and diverging monetary policies. The dollar strengthened more against major currencies between July 2014 and March 2015 than it had during any similar period since 1981 (IMF, 2015a). This dollar appreciation and the resulting upward revaluation of foreign currency liabilities, created balance sheet strains for indebted companies and governments in the semi-periphery. This accentuated financial outflows from the semi-periphery, but also pressured down even more commodity prices. The dollar appreciation also depreciated even more commodity prices.

As hard currency reserves began to dwindle and debt levels were seen to be unsustainable with the fall of commodity prices and trade balances, numerous semi-periphery economies began to experience capital outflows, financial distress, and recession (Müller et al., 2017; Caupin, 2014; Conti-Brown and Lastra, 2018). Many underwent currency, banking, and debt crises (Brazil in 2015, Argentina since 2013-20, Venezuela in 2017, Egypt in 2016, Russia and Ukraine in 2014, Kazakhstan and Tajikistan in 2015, South Africa in 2015, Turkey since 2018).[70] Semi-periphery

[69] We can note that the countries affected by the turbulence were different from those of summer 2013. For example, Turkey and South Africa, little affected in 2013, were affected this time around, while Indonesia and India, which had concentrated the tensions in 2013 were little or not at all affected, with the economic policy measures taken following the first phase beginning to bear fruit.

[70] China also experienced a substantial financial distress in 2015-2016. See online appendix (Subsec-

economies that relied heavily on commodity exports (e.g., Saudi Arabia, Russia, Venezuela, Nigeria, Colombia, Malaysia, Chile, Argentina, Peru, Brazil) showed declining revenue, rising public debt, and had generally the greatest deterioration of their GDPs.[71] Yet the downturn did not become generalized, in comparison to the crises in the 1980s and 1990s.

t_5 - aftermath.

By the late 2010s, the CLIF cycle and the values of the financial assets in the center were rising (see Figure 3-11). Few economists were raising concerns related to the financial bubbles in the center and the rise of risky loans, notably on the US markets.[72] Likewise, the macroeconomic adjustments in several semi-periphery economies enabled them to improve their balance of trade (see Figure 3-12) while the net financial inflows to the semi-periphery remained low, with net outflows of portfolio investments and other investments (see Figure 3-11 and 3-13).

It was in this context characterized by semi-periphery economies in recent or ongoing BOP crises and center economies in the upward phase of the CLIF cycles that the COVID-19 pandemic and its resulting lockdowns, struck the global economy. The financial markets experienced a momentous fall in February 2020, but this was countered by even more drastic injections of liquidity by the central banks of center economies than in 2008 and by government subsidies to enterprises and households. Public debt as well as financial and real-estate markets continued to rise throughout 2021. Available figures and evidence since 2020 show that the pattern of large financial flows confirm the continuation of the destabilizing effects of trade-offs between investment opportunities in the center and in the semi-periphery economies.[73]

tion B.5.3) for details.

[71]In several semi-periphery economies, lower commodity prices boosted consumption, decreased inflationary pressures, and helped offset lost output from general trade shocks. For example, India, Turkey, and the Philippines (net commodity-importers) partially reduced their external imbalances thank to lower import costs.

[72]For example, see the "Keynote address from Janet Yellen on the tenth anniversary of the financial crisis," by Janet Yellen, *Brookings*, November 19, 2018.

[73]For example, the end of 2020 has seen "*the strongest flows to [emerging market] assets since the first*

3.4 Conclusion

The paper discusses how a periodic pattern characterizing international financial flows can be understood as the main trigger of balance-of-payment financial crisiss (BOP crisiss) in semi-periphery countries. The medium-term Center Leader economies' Industrial-Financial cycles (CLIF cycles) are considered the root of asymmetrical and cyclical financial interdependencies between center and semi-periphery countries. The search for short-term yields by investors of the center pushes them to allocate a larger share of their funds to the semi-periphery during periods of low profitability in center economies (the downward phases of CLIF cycles), and in particular in semi-periphery countries experiencing major domestic pull factors or positively affected by major international pull factors. This leads to large financial inflows to the semi-periphery and hence triggers the creation of major wealth effects and financial hot spots. The process ends due to (i) the ending of the downward phase of the CLIF cycles and the developments of new profitable investment opportunities in the center and/or (ii) the emergence of major international and/or domestic push factors that provoke large and disruptive financial outflows from the semi-periphery. In both cases, involved economies of the semi-periphery experience periodic credit gluts and crunches that generate serious financial crises. In short, the downward phases of CLIF cycles create the conditions for the BOP crises in semi-periphery countries

A historical review of the BOP crises in the semi-periphery between 1970 and 2020 highlights the importance of the CLIF cycles, as well as the role of major pull and push factors. Three periods (1970-90; 1991-2001; 2002-2019) are distinguished regarding the evolution of the nature, magnitude and, impact of international financial flows between center and semi-periphery countries. We show that for every period the downward phase of CLIF cycles triggered considerable financial inflows to the semi-periphery and created

quarter of 2013" and "*the exodus of capital from emerging markets [following the covid outbreak] is now firmly in the rear-view mirror and robust inflows look set to continue.*" In addition, some analysts already "*warned that the rally fuelled by the abundant cash in search of investments and the optimism over an end to the pandemic could run out of steam.*" These references come from "Foreign investors dash into emerging markets at swiftest pace since 2013," *Financial Times*, January 30, 2021.

condition for three waves of BOP crises in the semi-periphery in 1980-1990, 1994-2002, and 2007-2018.

4 | International Monetary Spillovers

Monetary policy response or economic integration: what drives international monetary policy spillovers ?[1]

Abstract

This study examines international monetary policy spillovers over the past four decades. Specifically, we are able under reasonable assumptions, to disentangle the evolution of spillovers (i) driven by changes in the economic relationship between countries from those (ii) driven by changes in how these countries react to foreign factors. We do so by estimating a time-varying spatial regression model based on maximum likelihood and local kernel techniques. Overall, our results indicate that spillovers are sizable and have increased considerably since the 1980s, suggesting that countries have partially lost their monetary autonomy. However, this result hides heterogeneous patterns. While economic integration increased markedly during this period, central banks tended to react less, for a given level of integration, to foreign policies. Exploring the role of the Federal Reserve, our results support the existence of a multipolar, rather than unipolar, system over the entire period, on average. We show that the US interest rate was a major source of monetary spillovers in the 2000s. However, its influence has declined since the global financial crisis.

Contents of the chapter

[1]This chapter is the result of a research developed in collaboration with Alexandre Girard and Jean-Yves Gnabo.

4.1 Introduction

In this study, we empirically document international monetary policy spillovers over the past four decades. This topic has drawn much attention from academic literature amid rising concerns that fast-growing economic integration ("globalization") would eventually jeopardize monetary policy independence (Breitenlechner et al., 2021; Antonakakis et al., 2019; Montecino, 2018). From a policy perspective, a critical question about the international transmission of monetary policy across time is whether the observed changes are driven by the evolution of the economic relationship between countries or by changes in how these countries react to foreign factors. Surprisingly, this issue has received limited attention so far in the empirical literature (see Crespo Cuaresma et al., 2019).[2] Going beyond the estimation of time-varying spillovers by separating both drivers is not trivial and requires overcoming critical hurdles. This is the main purpose of this study. We address this problem by developing an original empirical strategy. In summary, we first estimate a time-varying spatial regression model based on local kernel techniques. Second, relying on weak assumptions on our spatial interaction matrix, we use its larger eivenvalue at each time period, later called scale factor, to recover the dynamics of both components – economic integration and policy sensitivity to peers – across time. Using this framework, we explore various questions regarding the international transmission of monetary policy, such as the international influence of the Fed.

Overall, the main questions we address can be expressed as follows. How did monetary spillovers evolve over nearly half a century? Are changes driven by changes in economic relationships between countries? Are they driven by changes in how central bankers react to the policies of their peers? If both are true, which one is dominant? Are international spillovers US-centered? Are we in a multipolar system, in which each country contributes to the international transmission of monetary policy? Does this vary over time?

Recent evidence from academic literature on international monetary spillovers shows

[2] In their study on monetary spillovers, Crespo Cuaresma et al. (2019) stress that they leave open the question of the forces driving the spillovers (i.e., economic integration and policy sensitiveness).

that these effects are sizable (Breitenlechner et al., 2021; Montecino, 2018). The US plays a central role (Ca' Zorzi et al., 2021, 2020), although impacted by the ECB, and subject to major spillbacks from its own policies (Breitenlechner et al., 2021; Antonakakis et al., 2019). The authors suggest a rising level of interdependencies rooted in financial and trade globalization. Overall, existing studies on international monetary policy spillovers can be classified into three approaches: base-country studies, bilateral VAR studies, or multipolar studies.[3] Base-country studies examine the pass-through of interest rates in a "base country" on foreign interest rates (e.g., Klein and Shambaugh, 2015; Shambaugh, 2004). Most "bilateral" VAR and global VAR studies investigate the impact of monetary policy shocks in a key central bank (usually the Fed or a small set of influential central banks like the ECB or the BoE) on international macroeconomic conditions (e.g., Breitenlechner et al., 2021; Ca' Zorzi et al., 2021). More recently, studies have adopted multipolar modeling of monetary spillovers using global VAR techniques (Dées and Galesi, 2021) or spatial econometrics (Montecino, 2018). However, there is still a poor understanding of the evolution of these spillovers over time. This is partially because this task is "computationally challenging" (Crespo Cuaresma et al., 2019). As noted in Crespo Cuaresma et al. (2019), there is limited evidence to support that the strength of spillovers has weakened in the aftermath of the global financial crisis, while Antonakakis et al. (2019) argue the opposite. These diverging views illustrate the need for further assessments.

As illustrated by Figure 4-1, which reports the global trends of government bond interest and monetary policy rates for a large sample of developed and developing countries, changes in interest rates are largely synchronized (Kharroubi and Zampolli, 2016; Chatterjee, 2016). Interestingly, this trend is observed regardless of the exchange rate regime. This apparent discrepancy between de facto policy rate comovement and de jure monetary policy autonomy raises questions about the evolution over time of monetary policy independence and the Mundell–Fleming model (Fleming, 1962; Mundell, 1963).[4] In that

[3] See Montecino (2018) for a more in-depth discussion on the importance of the multipolar approach and a comparison between these categories.

[4] The Mundell–Fleming model has been used by economists (e.g., Obstfeld et al., 2005) to argue that a country (or a set of countries belonging to a monetary union) can only pursue two of the following three

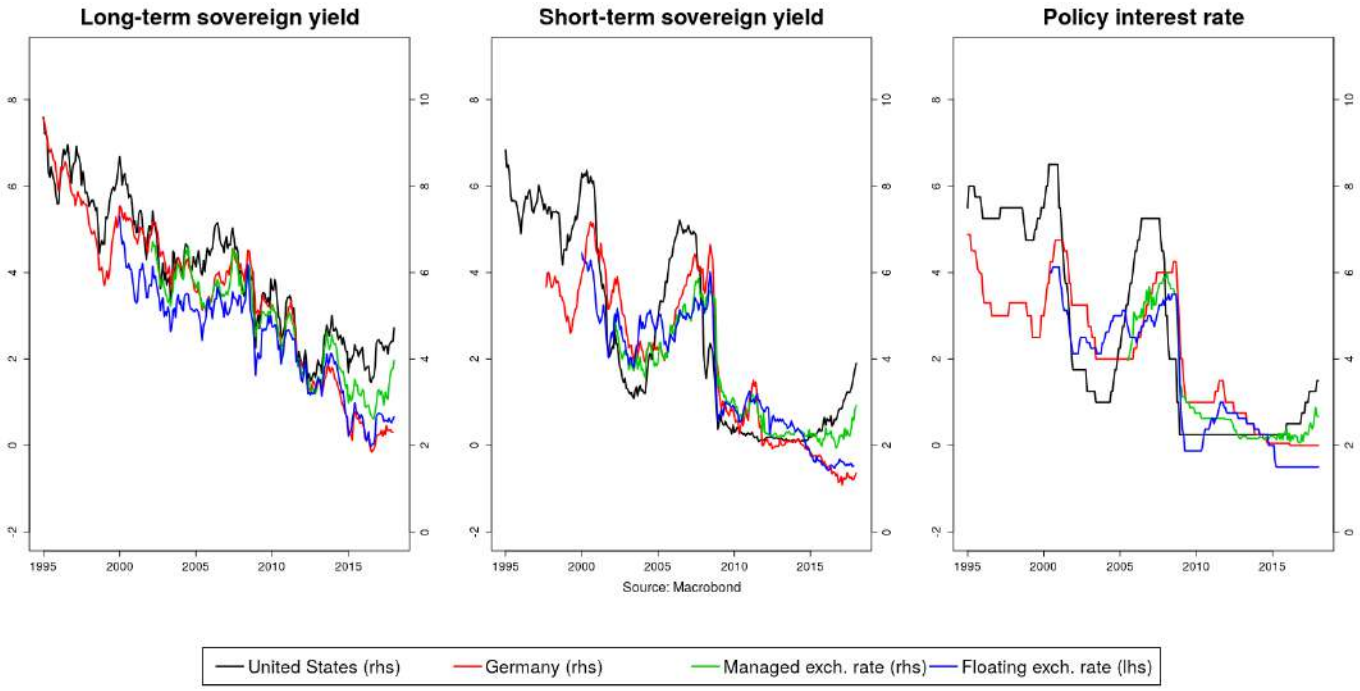


Figure 4-1: Common Trends in Monetary Policy

regard, two main considerations are worth mentioning. Firstly, the Mundell–Fleming model suggests that rising capital mobility would lead to a greater proximity between policy interest rates as a smaller variation in these rates would induce a larger effect on capital flows and so on economic output. In this context, rising comovements in interest rates do not imply a loss in monetary autonomy as central banks could induce a larger effect on economic output by a smaller variation in their policy interest rates.[5] Yet, in a financially integrated world, other channels of interactions emerged that could alter this initial interpretation.[6] As an illustration, the initial effect of a monetary loosening could be deteriorated by the presence of large foreign debt leading to balance sheet effects.[7]

goals simultaneously: (i) significant capital mobility (i.e. absence of capital controls), (ii) autonomous monetary policy, and (iii) fixed foreign exchange rate. This led to the concept of Mundell's trilemma, also called *impossible trinity*.

[5]In the Mundell-Fleming model with floating exchange rates, if a central bank opts for an expansionary monetary policy by increasing the exogenous supply of money, the domestic interest rate decreases, thereby increasing investment and economic output. As the interest rate has fallen below the international rate, this also leads to nominal exchange-rate devaluation. Given fixed nominal wages and/or prices, this also leads to a real exchange rate devaluation and increased net exports, shifting the IS curve to the right, and thus increasing even more economic output.

[6]The diversity of monetary policy transmission channels and their interactions with economic globalization introduced in Section 1.3 are examples.

[7]Interested readers can refer to Rey (2016) as well as neo-Keynesian models (Woodford, 2003; Galí, 2015) for more in-depth analyses.

Secondly, in a pioneering contribution, Rey (2015) argues that the Mundell's trilemma has morphed into a dilemma between capital mobility and monetary policy autonomy due to the development of financial globalization. A central argument is that due to global financial cycles (non-US) central banks partially lose the ability to control domestic long-term interest rates which are the central element of the interest rate channel (e.g., see Shin, 2012; Miranda-Agrippino and Rey, 2015; Passari and Rey, 2015; Bruno and Shin, 2015; Rey, 2015, 2016; Georgiadis and Mehl, 2016). This study opened a vast debate on the literature on the empirical validity of the Mundell trilemma (e.g., see Passari and Rey, 2015; Klein and Shambaugh, 2015; Obstfeld, 2015; Kharroubi and Zampolli, 2016; Aizenman et al., 2016; Rey, 2016; Caceres et al., 2016; Disyatat and Rungcharoenkitkul, 2017; Bekaert and Mehl, 2017). Recent results tend to (partially) confirm these claims by providing evidence that economic integration has reduced the effectiveness of the floating exchange rate regime in isolating from financial pressures (Han and Wei, 2018; Ligonniere, 2018; Cheng and Rajan, 2020). This empirical study does not provide direct evidence on losses or gains in monetary policy autonomy and does not aim at directly testing the Mundell's trilemma. However, it does provide findings regarding the pattern of interactions between policy interest rates over the last four decades, which in turn provides insights of the validity of hypotheses related to the Mundell's trilemma and monetary independence in general.

To our knowledge, this study is the first attempt to (i) evaluate the evolution of spillovers over the last four decades, (ii) propose a method to disentangle the role of economic integration from the sensibility to peers' monetary policy, and (iii) assess the evolution of the US influence in a multipolar framework. Therefore, this study contributes to the literature by providing new evidence. First, our estimates support that spillovers are sizable and indicate that spillovers considerably increased during the 1980s and aftermath of the GFC. Second, our estimation results show that economic integration has played a growing role as a determinant of monetary policy spillovers over the last four decades. Third, we document the major influence of the Fed on other central banks (especially during the 2000s). However, since the GFC, the influence of the Fed has declined, and central bank monetary policy decisions tend to be even more multipolar than unipolar (or US-centered). Several robustness exercises were performed. Because this study focuses on the evolution of international monetary policy interest rates, the baseline scenario could include a sample bias as we maximize the time span of this sample (and compromise on the number of countries). Although impacted by their peers as discussed in this study, central banks' decisions incorporate domestic factors, the most important of which being the level of inflation. As China has become a major trade player while still maintaining capital control policies, the inclusion of this country in the sample is a major point of interest. For these reasons, we tested different specifications, with different samples, with or without inflation measures, and with or without China. As documented below, our findings are robust to these different specifications (and others).

The remainder of this paper is organized as follows. Section 4.2 describes the data and empirical identification strategy. The main empirical results on the evolution of monetary spillovers are presented and discussed in Section 4.3. Section 4.4 discusses the monetary singularity and influence of the US on other monetary areas. Finally, Section 4.5 summarizes the empirical results, and Section 4.6 concludes the paper.

4.2 Data and methodology

This section describes the data and empirical identification strategy developed to measure the time-varying spillovers of monetary policy rates.[8]

[8] Details of the construction of the dataset, every country, and each sample are reported in Appendix C.1. An online appendix is available at www.benjaminpeeters.com/research/a/appendix-pgg. The dataset is available online at www.benjaminpeeters.com/research/d/data-pgg. An R package containing the codes for the estimation procedures discussed in this section is also available online at www.benjaminpeeters.com/research/c/code-pgg or on Github at github.com/benjaminpeeters/TVSR.

4.2.1 Measure of monetary policy

To assess international monetary policy spillovers, we rely on observations of a large cross section of monetary policy rates at a monthly frequency over a long period. Econometric techniques were applied to seven samples because of data availability, and to confirm the robustness of the results. In the baseline scenario, the sample, called Set 1, consists of monetary policy rates for 29 monetary areas observed over the longest time span; between 1982 and 2021.[9] The dataset is primarily composed of data collected by the BIS. To expand the time span of the samples, we supplement these data with information gathered from the OECD, Macrobond, Datastream, and Central Banks as well as specific data for the shadow rates. Relying on similar sources, six other samples, from Sets 2 to 7, extend the cross-sectional dimension to include up to 75 monetary areas, covering at least a period of 20 years.[10] In these samples, Eurozone countries have been treated as a unique entity, reflecting that these countries have shared a common monetary policy set by the ECB since 1999. Before 1999, the Eurozone countries were represented by German monetary policy rates, as this country played the role of anchor, or base, country for most of the period since 1973.

For a large part of the sample, conventional short-term monetary policy rates ensure an appropriate representation of the inclination of central banks and monetary authorities toward monetary policy. However, the GFC and the more recent COVID-19 crisis showed that nominal policy rates can be constrained by the zero lower bound and therefore do not account for recent monetary policy accommodations implemented through unconventional measures. To alleviate these shortcomings and consider unconventional monetary policies, the samples are completed with estimates of shadow rates (Krippner, 2013) in advanced economies constrained by the zero lower bound.[11]

[9] The monetary areas included in this sample are Algeria, Australia, Bangladesh, Belize, Canada, Denmark, Ecuador, Eurozone, Gambia, Ghana, Guyana, India, Iran, Jamaica, Japan, Jordan, Lebanon, Malaysia, Mauritania, Mexico, Nepal, New Zealand, Norway, Sierra Leone, South Africa, Sweden, Switzerland, the UK and the US. Except for the Eurozone, all monetary areas were countries.

[10] See Subsection 4.3.3 for additional information about the other samples.

[11] Details regarding the definition and computation of shadow policy rates can be found in Krippner (2013) and Wu and Xia (2016). The benchmark shadow rates used in this study are those defined by

4.2.2 Baseline econometric model

Spatial econometrics offers relevant tools to capture spillovers through spatial dependencies, which arise when values (interest rates) at one location (a monetary area) depend on the values of variables observed in nearby locations (e.g., through economic connections). These econometric techniques have been introduced in financial literature to capture international risk spillovers (Debarsy et al., 2018), bank credit risk commonalities (Wang et al., 2019), or monetary spillovers (Montecino, 2018). Furthermore, Blasques et al. (2016b) states that spatial dependence parameters measured by spatial regressions are more structural and better-suited estimates for assessing whether spillover strength has changed over time. Based on their argument, we rely on a spatial econometric model to assess the magnitude of international spillovers in monetary policy.

The DGP of the workhorse spatial panel sample of n observations $y_{it},\ i = 1, \dots, n, \forall\, t \in \{1, \dots, T\}$ is the following spatial autoregressive process:

$$y_t = \rho W y_t + Z^{-1}\alpha \mathbf{1}_n + \varepsilon_t, \qquad \varepsilon_t \sim \mathcal{N}(0, \sigma^2 I_n), \qquad \forall t \in \{1, \dots, T\} \tag{4.1}$$

where $y_t = (y_{1t}, \dots, y_{nt})'$ denotes the vector of n cross-sectional observations at time t. These entries are monthly measures of monetary policy rates (see Subsection 4.2.1). The *spatial weighting matrix* W is an $n \times n$ matrix modeling interdependencies between monetary areas during the overall period. It captures the proximity between the different locations, which is the relative influences of peers. ρ is the unknown *cross-sectional spatial dependence parameter* and α is the unknown scalar intercept. The strength or intensity of monetary policy spillovers across monetary areas is measured by the estimated spatial dependence parameter, or spatial correlation, $\hat{\rho}$. This estimate captures how much a central bank adjusts its decision to its neighbors. $\mathbf{1}_n$ is an $n \times 1$-vector of ones. ε_t is an $n \times 1$ disturbance normally distributed vector with mean zero and unknown variance

Leo Krippner and LJK Limited (https://www.ljkmfa.com/) for the US, the Eurozone, Japan, the UK, Switzerland, Canada, Australia, and New Zealand). Alternative shadow rates were tested and the results were similar than those of this study. Results are available upon request.

σ^2. As commonly assumed in spatial analysis, we consider that the inverse matrix $Z = (I_n - \rho W)^{-1}$ exists, with I_n denoting the $n \times n$ identity matrix. For the model to be stable, the value of ρ should be such as $\rho \in [-1; 1]$.[12]

The spatial weighting matrix W, also called the transmission channel matrix, is a function of geographic, political and/or economic distances, which *exogenously* defines a neighborhood or interaction structure between the entries y_t.[13] The *spatial lag* Wy_t is defined as the vector of the W-weighted means of the observations y_t. For instance, the i-th value of the spatial lag represents the following linear combination constructed from neighbors of the country i: $\sum_{\forall\ j \neq i} w_{ij} y_{jt}$, where w_{ij} refers to elements composing W. Then each observation y_{it}, for $i = 1, ..., n$, of the vector y_t depends on the other observations y_{jt}, $\forall\ j \neq i$ toward multiple transmission channels defined by the spatial weighting matrix W. In our context, Equation 4.1 posits that domestic monetary policy rates are a function of the monetary policy rates of their peers through a network, modeled by the given structure of the transmission channel matrix W. Domestic monetary policy rates ultimately depend on both the exogenous determinants of their peers and their idiosyncratic errors. The relative influence of a central bank on its neighbors varies according to its proximity through the spatial weighting matrix W, resulting in some central banks having more influence than others on their peers' monetary policy rates.

Even though elements composing the disturbance vector ε_t are independently distributed with the following diagonal covariance matrix $\Sigma = \sigma^2 I_n$, the reduced form term $\epsilon_t = Z\varepsilon_t$ has a covariance structure $Z\Sigma Z^T$. This relaxes the independence assumption of non-spatial baseline econometric models and introduces heteroscedasticity and cross-correlations among idiosyncratic monetary policies. As the covariance structure is determined by the (exogenously supposed) spatial weighting matrix W, we can decompose the estimated covariance matrix into a network component $\hat{Z}$ and an error component $\hat{\Sigma}$. The structure of Equation 4.1, notably the covariance structure of ϵ_t, leads to an endogeneity

[12] This is necessary for the shocks on ε_t to die out over spatial contagions; meaning that $I_n - \rho W$ is non-singular (see below for details on the normalization of W_t).

[13] We provide further details on the spatial weighting matrix in Section 4.2.3 in a time-varying framework.

issue and causes the ordinary least squares (OLS) estimator to be inconsistent (Anselin, 1988). As an alternative, the parameters can be estimated by the maximum likelihood (ML), quasi-ML, or generalized method of moments (GMM).[14] As commonly performed in the spatial econometric literature (Blasques et al., 2016b; Anselin et al., 2008; Elhorst, 2005; Ord, 1975), we rely on an ML-based estimation procedure (Subsection 4.2.6 details the estimation procedure).

4.2.3 Dynamic monetary spillovers

The baseline model detailed in Section 4.2.2 is static. Monetary spillovers, captured by ρ, as well as the spatial weighting matrix W, are assumed to be time-invariant. As explained above, however, such an assumption seems unlikely considering the time span and existing evidence from the literature (e.g., see Antonakakis et al., 2019; Crespo Cuaresma et al., 2019). To allow estimates to vary over time in our model, we theoretically consider a modified version of the DGP based on Equation 4.1, in which both the new spatial dependence parameter ρ_t and spatial weighting matrix W_t can change with time. The dynamic model is expressed as the following DGP:

$$y_t = \rho_t W_t y_t + Z_t^{-1} \alpha_t \mathbf{1}_n + \varepsilon_t, \qquad \varepsilon_t \sim \mathcal{N}(0, \sigma_t^2 I_n), \qquad \forall t \in \{1, \dots, T\} \tag{4.2}$$

where $Z_t^{-1} = (I_n - \rho_t W_t)^{-1}$ and ρ_t, α_t and σ_t are time-varying estimates. For each period t, they share the same dimensions with their equivalent presented in Equation 4.1. To be fully dynamic, we complete the model by enabling the common trend, or intercept, and the variance to be time-varying.

This time-varying model is suited to assess international monetary policy spillovers over time and enables us to distinguish between two components at the origin of the spillovers, the scale factor – a measure of economic integration – and the sensitivity – the

[14]Interested readers may find it useful to consult Anselin (1988) and LeSage and Pace (2009) for two detailed discussions of the parameter estimation. In addition, Lee and Yu (2010) provide a survey of panel-data spatial lag models and estimation techniques.

reactivity of central banks to other central banks' policies at a similar level of integration. Yet, while offering an appealing setup to assess the evolution of monetary spillovers, this model comes with a couple of challenges regarding the estimation procedure and the identification strategy of the parameters. The first difficulty lies in normalizing the time-varying spatial weighting matrix W_t. The second challenge relates to the potential endogeneity bias induced by the dynamics of the W_t. Before further explaining our identification strategy in Subsection 4.2.5, we detail the estimation of the time-varying spatial weighting matrix and these two challenges.

4.2.4 The spatial weighting matrix

The network structure connecting monetary areas must be specified *a priori* to build the spatial weighting matrix, W_t. In our dynamic framework, we need a bilateral peer structure with a few features: it must approximate the long-term nature of the peer structure, evolve over time to capture medium-term changes, capture economic interdependencies and include a sufficiently large set of countries over a long period of time to enable the identification. Two clear strategies are the use of measures of international trade or capital flows. In this study, we compute the spatial weighting matrix W_t with data on gross bilateral international trade positions at an annual frequency obtained from the International Trade Statistics UN Comtrade dataset (see Appendix C.2.3 for more information on the evolution of international trade flows and the transmission channel matrix over the period). Several advantages arise from the use of international trade relative to capital flows. First, it is a well known feature that trade flows are more stable and move more slowly than financial flows. Therefore, trade flows are more likely to characterize the structural nature of the interaction network more appropriately. This is very valuable for our identification strategy, which relies on the absence of short-term fluctuations of the transmission channel matrix to (i) properly identify the scale factor and (ii) avoid endogenous biases (see below). Second, the UN Comtrade dataset includes a large set of countries over a long period of time, enabling the construction of a spatial weighting matrix W_t to estimate a relevant spatial coefficient ρ_t that captures the heterogeneity of monetary areas on a large sample.[15] Obtaining bilateral financial connections of a large set of countries is usually offset by the lack of data and transparency due to the critical nature of data. Alternative measures of economic proximity, such as bilateral financial or FDI flows, were considered without being as reliable.[16] Third, financial connections could be blurred by the existence of financial hubs, tax havens or offshore centers (e.g., Singapore, Switzerland, the Cayman Islands) that could alter the significance of our results. Fourth, recent studies have shown that trade linkages have a significant impact on dynamic evolution of monetary policy comovement and bond market connectedness (Chatterjee, 2016; Akovalı and Yılmaz, 2021).

Fifth, international trade is a widely used proxy for capturing economic integration and building interaction networks (e.g., Dées and Galesi, 2021; Gygli et al., 2019). Therefore, we posit that exploiting international trade bilateral flow data is relevant to assess the degree of economic integration and, hence, build an indicator of spatial monetary policy spillovers.

In our dynamic framework, the normalization strategy of the spatial weighting matrix is central.It is necessary in every spatial technique to normalize the spatial weighting matrix (if not explicitly, implicitly made in the literature) and the choice of normalization can have major impacts on the estimates of the spatial correlation $\hat{\rho}_t$. In particular, some inappropriate techniques can artificially create intertemporal distortions in a spatial weighting matrix. Importantly, our identification strategy relies on a class of normalization: the unique-scaling factor normalizations.

Two common practices exist in the current spatial econometric literature to determine appropriate normalization. The first considers a *row-normalized* spatial weighting matrix W_t^r such that $\sum_{j=1}^{n} w_{t,ij}^r = 1, \; \forall \, i \in \{1, \ldots, n\}$. In other words, the sum of row connections

[15] Using this dataset to build the spatial weighting matrix, the main limitation in terms of data availability comes from the interest rates.

[16] For example, data obtained from the locational banking dataset from the BIS (an important alternative option) depends on the willingness of financial institutions to provide these data and the agreements of the institutions with the BIS. Moreover, this dataset contains a large number of missing observations for the countries and periods analyzed.

is equal to one at each period of time for each country. The second approach, which is called *spectral radius normalization*, is part of unique-scaling factor normalization strategies, which consists of dividing the unnormalized spatial weighting matrix W_t^* (defined by international trade flows) by a scale scalar, which corresponds to the larger eigenvalue (in absolute terms) of the matrix W_t^*. More specifically, the normalized spatial weighting matrix is defined by $W_t = W_t^*/s_t$ where $s_t = \max\{\mid \nu_{t1} \mid, \ldots, \mid \nu_{tn} \mid\}$, and $\nu_{t1}, \ldots, \nu_{tn}$ denote the eigenvalues of W_t^*.[17]

We adopted spectral radius normalization rather than row normalization for three main reasons. The motivation for row normalization is that it ensures that $\sum_{ij} \hat{w}_{tij}^r = n$ in every period. Moreover, as the spectral radius normalization, row normalization has the advantage that W_t^r is such that $I_n - \rho_t W_t$ is nonsingular for all values of ρ_t in the interval $[-1; 1]$. Nevertheless, this normalization strategy suffers from two main drawbacks: (i) it creates distortions in the "structure" (or shape) of the transmission channel matrix, and (ii) these distortions are likely to be different for every time period. First, the row-normalized matrix relies on the different normalizing factors for each row. Hence, there exists no corresponding rescaling factor for the spatial dependence parameter. We do not have the important property that $W_t^r \propto W_t^*$, contrary to spectral radius normalization, where $W_t \propto W_t^*$. Consequently, we cannot base the estimation on the assumption that W_t^r represents the structure of the matrix W_t^*. Then the model would not correspond to the assumed DGP.[18] Unless theoretical issues suggest a row-normalized spatial weighting matrix, resulting in the definition of an alternative DGP, which is not the case in this

[17]Other unique-scaling factor normalizations also exist. For example, it is possible to normalize using the sum of all elements composing W_t^*. To have the property that total spillovers ($= \rho_t \sum_{ij} w_{tij}$) are proportional to ρ_t, a relevant assumption is that $\sum_{ij} w_{tij} = c$, where c is a constant. Hence, an intuitive normalization is $W_t = W_t^*/s_t^{\Sigma}$ where $s_t^{\Sigma} = \sum_{ij} w_{tij}^*/n$ such that $\sum_{ij} \hat{w}_{tij} = n$ (as in the case of row normalization). This normalization is very close to spectral radius normalization and has the advantage of enabling direct economic interpretation. However, this procedure has not been mentioned in spatial econometric literature. This is because no statistical property exists that ensures that $I_n - \rho W$ is non-singular, and hence, the model will be stable with $\rho \in [-1; 1]$. Kelejian and Prucha (2010) prove that it is the case for spectral radius normalization. However, both normalizations induce very close estimations of ρ_t in our case (the results are available upon request). Based on these empirical results, spectral radius normalization enables the interpretation of ρ_t as being proportional to the total spillovers ($= \rho_t \sum_{ij} w_{tij}$), which is an argument in favor of this normalization strategy.

[18]$\bar{W}_t$ is assumed to have a "structure" close to W_t^* (see Appendix C.2.1 for more details).

analysis, the approach will in general lead to a misspecified model and blur the estimation of ρ_t.[19] Second, if this deformation effect generated by the row normalization could be tractable for time-invariant spatial weighting matrices, it is no longer the case in a dynamic framework. As ρ_t is a unique scalar, while W_t^r depends on n row-normalization factors *at each period of time*, the estimation of the spatial dependence parameter ρ_t would be distorted if the weight between different rows evolves over time. In other words, the spatial dependence parameter ρ_t would not be able to properly capture the strength of the spatial interaction, as it will be affected by a time-varying normalization, which affects not only the scale but also the structure of the network.[20] A third argument in favor of the spectral radius normalization is that it enables the novel identification strategy introduced in Subsection 4.2.5.Such strategy disentangles the two effects captured by the estimate of spatial dependence parameter ρ_t. For these reasons, this normalization procedure was preferred.

An additional issue in a dynamic framework is the emergence of a potential endogeneity bias induced by changes over time in the spatial weighting matrix, W_t. The main risk of bias comes from a potential reverse causality ($\Delta W_t \rightarrow \Delta y_t$). Such bias would arise if, for instance, monetary policy rates contemporaneously affect trade connections. Fortunately, the consequences on our estimations of $\hat{\rho}_t$ must be limited. Even though we can notice differences when considering a long-term series of several decades, it is a stylized fact that trade relationships across countries display remarkable inertia across years (particu-

[19] For more insight regarding the normalization discussion, please refer to Kelejian and Prucha (2010).

[20] To illustrate this, we consider a simple example. Assume that global trade flows are identical between periods t and $t+1$, except that Japanese trade with India significantly increases ($w_{t,IJ} < w_{t,IJ}$)). In the case of a unique-scaling factor normalization, this simply leads to an increase in the influence between these countries and a relative decreasing of all others. The relative influence between Canada and Mexico ($w_{t,CM}$) and between Canada and Japan ($w_{t,CJ}$) was the same in periods t and $t+1$. That means that ${}^{w_{t,CM}}/{}_{w_{t,CJ}} = {}^{w_{t+1,CM}}/{}_{w_{t+1,CJ}} = {}^{w^*_{t,CM}}/{}_{w^*_{t,CJ}} = {}^{w^*_{t+1,CM}}/{}_{w^*_{t+1,CJ}}$ and ${}^{w_{t,CJ}}/{}_{w_{t,IJ}} = {}^{w^*_{t,CJ}}/{}_{w^*_{t,IJ}} < {}^{w_{t+1,CJ}}/{}_{w_{t+1,IJ}} = {}^{w^*_{t+1,CJ}}/{}_{w^*_{t+1,IJ}}$. In the case of row normalization, the implications are less straightforward. This change also implied an increase in the relative influence of the connection between Japan and India. However, as the normalization is row-based, this change is associated with a relative decline in the influence of Japan and India with their trade partners, *but* not between these partners themselves. In other words, the relative influences between Canada and Mexico and between Canada and Japan are different in periods t and $t+1$, even if the underlying trade relations are identical. This means that ${}^{w^r_{t,CM}}/{}_{w^r_{t,CJ}} > {}^{w^r_{t+1,CM}}/{}_{w^r_{t+1,CJ}}$ as $w^r_{t,CJ} > w^r_{t+1,CJ}$ (same rows) and $w^r_{t,CM} = w^r_{t+1,CM}$ (different rows). As this phenomenon can occur during every period, row-based normalization can lead to intertemporal distortions in a dynamic framework.

larly when compared to financial flows or interest rates). Generally, the structure of the interaction network (represented by the trade-based spatial weighting matrix W_t) must change more slowly than the entries (i.e., the policy rates). Therefore, assuming that the spatial weighting matrix W_t evolves smoothly and gradually over a year is a reasonable assumption. This supports the exogeneity assumption required by spatial regressions. Any potential endogeneity bias would be at most very small and would not affect the estimate of the spatial dependence parameter ρ_t. Indeed, if the dependence across policy rates is changing at a higher frequency than W_t, our estimation procedure should better identify the dependencies in central bank decisions stemming from the strength of the spillovers, ρ_t, than from the changes in the structure of economic integration, W_t.[21]

4.2.5 Identification strategy

Based on spectral radius normalization, the normalized spatial weighting matrix W_t used in the estimation procedure of ρ_t in Equation 4.3 is defined by $W_t = W_t^*/s_t$, where s_t denotes the maximum of all eigenvalues (in absolute value) of the unnormalized spatial weighting matrix W_t^*. Hereafter we call this parameter the *scale factor*, as changes of this scalar closely follow the evolution of the scale of international trade flows. Therefore, it can be used as a convenient and synthetic estimate for global economic integration. Using the scale factor, we can rewrite Equation 4.2 as follows:

$$y_t = \rho_t W_t y_t + Z_t^{-1}\alpha_t \mathbf{1}_n + \varepsilon_t = \theta_t W_t^* y_t + Z_t^{-1}\alpha_t \mathbf{1}_n + \varepsilon_t, \tag{4.3}$$

where θ_t is called the *sensitivity*, symbolizing the intensity of the spillovers divided by the scale factor, that is, $\theta_t = \rho_t/s_t$. The spatial dependence parameter ρ_t can be interpreted as a measure of the strength or intensity of international monetary policy spillover over time. By contrast, the sensitivity θ_t is a measure of the strength of monetary interdependencies conditional on a specific level of economic integration. It represents how much

[21]Interested readers can usefully refer to Wang et al. (2019) for additional discussions on how different paces mitigate the endogeneity risk of the spatial weighting matrix.

a central bank adjusts its decision to its neighbors for constant flows of goods, services, and capital, that is, the sensitivity of monetary authorities in the implementation of their monetary policy to the stances of their peers. This decomposition is fruitful, as it enables the distinction of international monetary policy spillovers that can arise from two main sources: a change in economic integration that alters the exposure to international factors and disturbance from other countries (the scale factor s_t), and a variation in the monetary policy strategy or reactivity to other central banks' decisions for a given level of economic integration (the sensitivity θ_t).

4.2.6 Estimation procedure

To estimate the dynamics of ρ_t, α_t, and σ_t^2 in Equation 4.2, we propose a novel approach based on a semi-parametric local kernel framework: the local kernel spatial regression (LKSR). The methodology, which has not yet been applied to spatial models, is an adaptation of the local kernel regression framework that has a few good properties; it is robust, converges easily, and provides good estimation performances, for example, when it is compared to the SDSR, discussed in Appendix C.6.1.

Local kernel regressions are performed locally, meaning that the value of an estimated coefficient at a location or time is only influenced by the information within a narrow neighborhood of that position. The main advantage of this methodology lies in its ability to reduce the probability of model overfitting (Ashley et al., 1980). It has become very popular in economics and finance to improve forecasting performance, particularly in the presence of structural changes in the data (Stock and Watson, 2007). Additionally, local kernel regressions are particularly suitable for estimating time-varying parameters.

Based on the principles of local kernel regressions, we developed a semi-parametric time-varying local kernel spatial regression called LKSR. For every period t, we estimate a spatial dependence coefficient $\hat{\rho}_t$, an intercept coefficient $\hat{\alpha}_t$ and a variance coefficient $\hat{\sigma}_t$ using a specific kernel-weighted subsample. The global estimation process behind the

LKSR is given by the following optimization procedure:[22]

$$\{\hat{\rho}_t, \hat{\alpha}_t, \hat{\sigma}_t\} = \arg\max_{\rho,\alpha,\sigma} \sum_{\tau=t-h/2}^{t+h/2} l(\rho, \alpha, \sigma|y_\tau) K_h\,(t-\tau) \qquad \forall\, t \in \{t-h/2\,;\, t+h/2\}\,, \tag{4.4}$$

where $K_h(\cdot) = K(\cdot/h)$ is the kernel function, and is usually chosen to be a smooth unimodal and symmetric function with a peak at 0. We imposed an additional normalization condition such that $\sum_x K(x) = 1$. The log-likelihood function l for the DGP defined by Equation 4.3, that is, in the case of a normal-distributed disturbance vector ε_t, is given by:[23]

$$\begin{aligned} l(\rho, \alpha, \sigma|y_t) &\equiv \log p\,(y_t \mid \rho, \alpha, \sigma) \\ &= \log \mid I_n - \rho W_\tau \mid - \frac{1}{2}\varepsilon_\tau^T \Sigma^{-1} \varepsilon_\tau - \frac{1}{2}\log \mid \Sigma \mid - \frac{n}{2}\log\,(2\pi)\,. \end{aligned} \tag{4.5}$$

The LKSR estimation procedure is influenced by a few metaparameters, including the window length or bandwidth h and the shape of the kernel function K. As it depends less on the shape of the kernel than on the value of its bandwidth, we chose a standard kernel shape, the Epanechnikov kernel, and developed an optimization procedure to select the most appropriate bandwidth. Hence, the optimal bandwidth is the result of a well-known trade-off between the bias and variance. In the empirical applications of this study, the bandwidth used is $h = 5$, which is determined by a cross-validation procedure.[24]

Simulations were performed to confirm the robustness and appropriateness of the proposed methodology. For conciseness, we only report estimations for our main scenarios in the core of the paper (e.g., using the same benchmark specification – same kernel function, same dataset, etc.). Yet it is worth mentioning that several simulation results reinforce our confidence on the approach. We tested different setups for the estimation

[22] Additional details of the LKSR approach are provided in Appendix C.5.1.

[23] The ML procedure formalized by Equations 4.4 and 4.5 implies to resolve $t-h$ nonlinear optimization problems, which can lead to high computing costs and/or convergence issues. To solve this difficulty, the three-dimension optimization problem is transformed into an one-dimension optimization problem, which is much easier to solve computationally. The developments are reported in Appendix C.5.2.

[24] Appendix C.5.3 details the cross-validation procedure and the selection of the bandwidth h.

procedure (based on Monte Carlo experiments and real data).

First, we tested the influence of modeling the intercept α_t and variance ε_t. Based on simulations and a theoretical analysis, we document that enabling the intercept and the variance to be time-varying is a crucial aspect because major biases may occur in the time-varying estimation procedure of ρ_t in the absence of these time-varying intercept and variance estimates.[25] We can mention that the LKSR approach is able to efficiently capture the common intercept and the standard deviation of monetary policy interest rates over our different samples and simulated data. The cross-sectional variance and the common factor of interest rates have a major decreasing trend during the period matching the trends exhibited by conventional descriptive statistics.

Second, our estimates suggest that changes in trade connections are very slow in comparison with the frequency of the changes in the observations y_{it}.[26] This supports the exogeneity assumption and confirms that any potential endogeneity bias would be very small. Moreover, a common technique in spatial regression to avoid endogeneity bias caused by a potential feedback loop or reverse causality is to use a lagged spatial weighting matrix (e.g., Blasques et al., 2016b). In this case, the spatial weighting matrix cannot cause any transformation in the observations for a clear temporal reason. We simulated our models based on different lags (from one month to two years). In all cases, the results were very robust.

Third, we tested a few metaparameters. We used different kernel functions and the simulations displayed very similar results. We assessed the impact of changing the bandwidth. As expected, small values of h lead to spiky and volatile estimates, whereas larger h values lead to oversmoothing. Overall, our core results were not affected by reasonable changes in the bandwidth. We checked if a restriction on the number of connections by countries could affect the results and found that the results are very robust to variations of this metaparameter.[27]

[25] See Appendix C.3 for more details on this argument.

[26] See details on the methodology and measures of these frequencies in Appendix C.2.2.

[27] See Appendix C.6.2 for details on the impact of the choice of the kernel function K, bandwidth h or constraint on the number of neighbors (i.e., the number of nearest neighbors k).

Fourth, we compared the LKSR to the generalized autoregressive score-driven framework developed by Blasques et al. (2016b) and Catania and Billé (2017). Our estimates on simulated and real data confirmed the usefulness of the LKSR approach and the robustness of the empirical results obtained by this method.[28]

Overall, our estimation procedure relies on two main hypotheses. First, a spatial weighting matrix built with bilateral international trade flow data and unique-scaling factor normalizations adequately represents the structural connections between economies through which monetary policy spillovers operate. Second, the time-varying spatial autoregressive process adequately models the spillovers between monetary policy stances. Assuming that these hypotheses hold, the LKSR procedure enables us to obtain relevant estimates of the spatial dependence parameter $\hat{\rho}_t$ of the time-varying spatial autoregressive model introduced by Equation 4.3; that is, the evolution of international monetary policy rate spillovers. Combining the dynamic aspect of bilateral trade flow data and spectral radius normalization, we propose to disentangle the origin of these spillovers between the role of the scale factor s_t and sensitivity to peers' interventions θ_t. Based on the existing literature, our Monte Carlo experiments, and our diverse estimates on real data, the procedure seems promising for providing accurate estimates.

4.3 Assessment of international monetary spillovers

This section details the core empirical results of the study. We first introduce our main results on the estimates of the spatial dependence parameter $\hat{\rho}_t$, the scale factor $\hat{s}_t$, and the sensitivity $\hat{\theta}_t$. We then discuss these results. We conclude with two key robustness checks.

[28]Elements concerning these comparisons are given in Appendix C.6.1, which introduces the SDSR approach and compares it with the LKSR approach based on Monte Carlo simulations and real data. Additional details are available upon request.

4.3.1 Results

The estimations by the LKSR procedure of the spatial dependence parameter, scale factor, and sensitivity for the baseline sample are reported in Figure 4-2. The left panel displays the value of the estimated spatial dependence parameter $\hat{\rho}_t$, which captures the intensity of international monetary policy spillover over time. The top-right and down-right panels, respectively, present the estimates of the scale factor $\hat{s}_t$, indicating the level of economic integration, and of the sensitivity $\hat{\theta}_t$, which assess the central banks' reactivity or responsiveness to their peers' monetary policy for the given level of integration. The black dotted lines are smoothed linear estimations highlighting longer-run trends for $\hat{\rho}_t$ and $\hat{\theta}_t$ to help read the figure.[29]

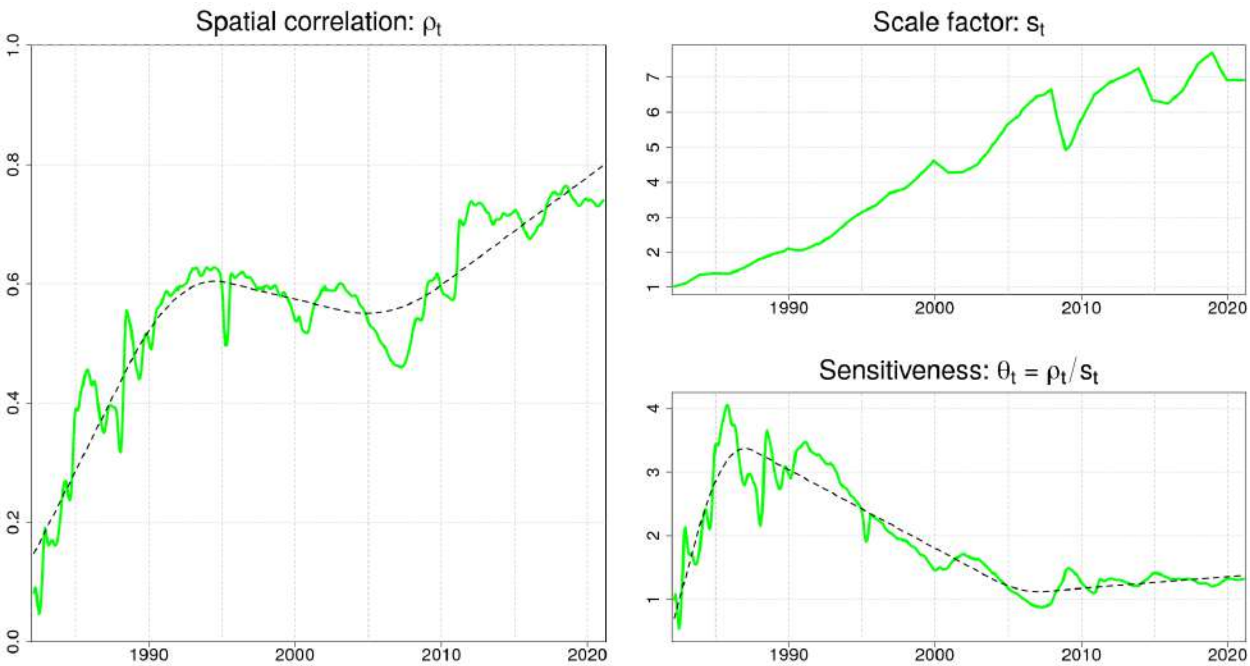


Figure 4-2: Spatial dependence parameter, scale factor and sensitivity – baseline dataset

For each panel, green lines report estimated-by-LKSR parameters. The black dotted lines are smoothed linear estimations of these parameters helping to see the trends. The left-hand panel shows the estimations of the spatial dependence parameter, ρ_t. The top-right panel displays the scale factor, s_t. The bottom-right panel exhibits the sensitivity, θ_t, which was normalized such that $\hat{\theta}_{t=1982} = 1$.

One of the most remarkable features revealed is the considerable increase in the intensity of international monetary policy spillovers; the estimations for the spatial dependence

[29]The estimations of the standard deviations $\hat{\sigma}_t$ and intercepts $\hat{\alpha}_t$ can be obtained upon request.

parameter, $\hat{\rho}_t$, evolves from around 0.1–0.3 in the early 1980s to around 0.7 in the 2010s. In line with the recent literature, spillovers have been sizable in recent decades (e.g., see Breitenlechner et al., 2021; Montecino, 2018). In addition, we observed that they markedly increased in the 1980s, the early 1990s, and after the GFC (in line with Antonakakis et al., 2019, for the aftermath of the GFC). Yet the LKSR also captures a salient sub-period for which we observe a decrease in the monetary-spillovers strengths; between the early 1990s and around the peak of the GFC in 2008, the estimate $\hat{\rho}_t$ drops from around 0.6 to around 0.45. Overall, the decrease was particularly noticeable around the GFC. The period between the early 1990s and the early 2000s can be regarded as a period characterized by a fairly stable intensity of international monetary policy spillovers.[30]

As mentioned in Subsection 4.2.5, our identification strategy enables us to disentangle monetary policy spillovers induced by the intensification of globalization (the scale factor s_t) from peer effects; that is, the sensitiveness of monetary policy decisions in response to the policies of other central banks at a given integration level (the sensitivity θ_t). Figure 4-2 shows that the global trend of the scale factor estimates for these last forty years is toward an increasing economic integration and a quasi-monotonically increase in $\hat{s}_t$. The scale factor has become more volatile in the last 20 years and trade integration has dropped a few times; the scale factor reduced slightly after the dot-com bubble crisis, plunged substantially after the GFC, and fell twice in recent years. However, these drops did not alter the overall increasing pattern, reflecting the general trend of globalization of economic exchanges.

Regarding sensitivity to foreign monetary policies, we observed three distinct salient periods. The sensitivity rose considerably during the 1980s. The addition of this surge in sensitivity ($^{\partial\theta_t}/_{\partial t} > 0$) with a steady rise in economic integration ($^{\partial s_t}/_{\partial t} > 0$) generated a boom in the intensity of international monetary policy spillovers ($^{\partial\rho_t}/_{\partial t} > 0$). Between 1990 and the GFC, the sensitivity of central banks decreased steadily. In the late 2000s it

[30] This period includes two abrupt drops. The first was in 1995 and the second was in the early 2000s. Based on a comparison with diverse samples (see Subsection 4.3.3), we can deduce that these two drops are due to very high interest rates in Mexico in early 1995 relative to other countries in the dataset and the dot-com bubble crisis in the early 2000s.

reached a level comparable to its initial value in 1982. During this period, the increasing economic integration ($\partial s_t/\partial t > 0$) is compensated by the reducing sensitivity of central banks' monetary policies ($\partial \theta_t/\partial t < 0$), such that the strength of international monetary policy spillovers is fairly stable or slightly decreasing ($\partial \rho_t/\partial t \leqslant 0$). This means that the trend toward more economic integration through trade is not always associated with an increasing sensitivity to other central banks' monetary policies or rising international monetary policy spillovers. Since the GFC, the estimations are marked by the resurgence of an increasing trend in spillovers, and the sensitivity estimate stops falling and fluctuates around a flat trend. By 2008, a continuous but more volatile integration process ($\partial s_t/\partial t > 0$) and a sensitivity varying around a flat trend ($\partial \theta_t/\partial t \gtrsim 0$) generated an upswing in international monetary spillovers ($\partial \rho_t/\partial t > 0$).

4.3.2 Discussion

The existence of large international monetary policy spillovers during recent decades suggests that one potentially important channel for the transmission of shocks worldwide is endogenous reactions of central banks to the monetary policies in neighboring economies. These spillovers represent significant threats to the achievement of monetary policy authorities' domestic objectives. Likewise, the estimates of the spatial dependence parameter $\hat{\rho}_t$ indicate that central banks' interest rates have become more aligned with those of their peers. Therefore, the results suggest that countries have partially lost their monetary policy autonomy through rising trade interconnections, in line with the hypothesis that monetary spillovers can largely be ascribed to economic integration (e.g., see Rey, 2015). Furthermore, from a longer-term perspective, the return of the sensitivity $\hat{\theta}_t$ in the late 2000s to its early 1980s level confirms the hypothesis that the fundamental driver of international monetary policy spillovers is the economic integration between countries. Accordingly, the spillovers exceeded their long-term trend in the 1980s and the early 1990s and subsequently returned to their long-term trend between the mid-1990s and 2008 due to a transitory surge and decrease in sensitivity (a $\cap$-shape). On this basis, a few recent developments in monetary policy strategies (e.g., inflation targeting) can be viewed as a set of reactions by central bankers to alleviate the impact of economic integration on their ability to deal with domestic factors (see details below). Overall, in the context of global economic integration characterizing the period, an increase (respectively a decline) in international monetary policy spillovers is caused by an increase (resp. a decrease) in the sensitivity of central banks to their peers' monetary policies and/or an accentuation (resp. a slowdown) in terms of economic integration. A large body of literature studied the causes of global and regional economic integration and notably found that trade and financial agreements decrease the cost of crossing borders (e.g., see Kepaptsoglou et al., 2010, for a literature review on free trade agreements), technological innovations decrease transport costs (Arvis et al., 2016; Bernhofen et al., 2016) and ease long-distance organization of production (e.g., see Freund and Weinhold, 2002, for the case of the internet), and promote the development of multinational enterprises (e.g., see Kiyota and Urata, 2008). Conversely, between 1982 and 2021, financial crises seem to be the most common drivers of short-term contractions in financial and trade flows, on a global scale.

Based on the LKSR estimations, international monetary policy spillovers decreased before the dot-com bubble crisis of the early 2000s and increased afterwards. This pattern reiterated a few years later; spillovers decreased before 2008 and then notably increased after the GFC. The two crises seem to have produced a V-shaped evolution of international monetary policy spillovers.[31] This suggests that during the period before the bursting of the bubbles countries had more diverging monetary policies relative to their trade partners and subsequently were more likely to react further to their peers' monetary policies. An illustration is the increase of ECB's policy rate in July 2008, when the Fed and the BoE had already drastically decreased their monetary policy rates.[32] After the Lehman

[31]The lack of a long-term perspective and the use of a time-varying framework in most studies makes it difficult to compare this pattern with the trends in the literature. Antonakakis et al. (2019) estimate international monetary policy spillovers in a time-varying VAR framework but including only the Fed, the ECB, the BoE, and the BOJ after 1995. They did not find a long-term rising trend, as shown in our figures (partially due to the absence of long-term data). However, two V-shaped patterns in spillovers are noticeable around 2000 and 2008.

[32]More specifically, the Fed sharply reduced the policy rates at the onset in September 2007 and then began forward guidance and asset purchases starting in December 2008. When the ECB was raising its

bankruptcy in September 2008, the ECB joined a coordinated rate reduction on October 8, 2008. Regarding this V-shaped pattern, it is worth noting that the recent COVID-19 crisis did not seem to have created a disruptive change in international monetary policy spillovers. Spillovers exhibited a moderately smooth and stable pattern in early 2020. A possible explanation is that the COVID-19 crisis was not a financial crisis spreading financial distress through economic partners but rather an abrupt and disruptive common shock that affected countries regardless of their economic links. Given that the spillovers remained very high in early 2020, another possibility is that the COVID-19 crisis may not have increased the spillovers because they were already very high (this is supported by our alternative estimations in Subsection 4.3.3).[33]

Before discussing the dynamic of the sensitivity in its historical context, we formulate a few general conjectures on the plausible drivers of the responsiveness of central banks.[34] We conjecture that the three main drivers that have markedly affected the global sensitivity θ_t are (i) the monetary policy strategies, (ii) the telecommunication systems, and (iii) the general development of the financial and economic globalization. First, the conduct of monetary policies is likely to significantly influence sensitivity. Monetary agreements between central banks can increase their reactivity to the monetary policies of their peers. Changes in monetary policy strategies – such as reserve accumulation and inflation targeting (Rossini et al., 2014) as well as central bank communication (Armelius et al., 2020) – can also alter responsiveness to external macroeconomic conditions. For example, some evidence suggests that an inflation-targeting strategy helped some countries have a smaller inflation response to oil price and exchange rate shocks, and strengthened their monetary

main refinancing rate, the Fed already had lowered its policy interest rate (the Fed Funds rate) from 5.25 % to 2 %.

[33] We can add that a more specific focus on the COVID-19 crisis using daily data and shorter temporal bandwidths could exhibit a different trend (for example, a similar V-shaped pattern) given that the shock has been particularly abrupt.

[34] In this regard, two additional comments concerning the connection between the scale factor s_t and sensitivity θ_t are worth noting. First, a few economic factors can affect and/or be affected by both the scale factor and sensitivity. For example, this is the case for the level of monetary cooperation among central banks or the development of the Internet and telecommunication systems. Second, we assume that sensitivity does not noticeably affect and/or is not affected by the synchronization of domestic factors, which is driven by economic integration. For conciseness, comments on these two arguments are reported in Appendix C.4.1.

policy independence and autonomy (Rossini et al., 2014; Mishkin and Schmidt-Hebbel, 2007).[35] More generally, empirical research supports the view that the more a foreign exchange rate regime is flexible, the greater the monetary independence and the more that monetary area is isolated from external monetary interventions or disturbances (notably the literature on the role of the Mundell trilemma, including Aizenman et al., 2016, 2010; Obstfeld et al., 2005; Shambaugh, 2004). The increase in central bank foreign reserves, called reserve accumulation, has been developed by a few central banks of emerging countries in order to be less sensitive to external factors, notably by self-isolating from currency crises and being more able to finance trade during sudden stop episodes (Chauffour and Farole, 2009; Ronci and Wang, 2006; Feldstein, 1999).[36] Moreover, reserve accumulation has also led to a decrease in interest rates of core economies (Warnock and Warnock, 2009) and semiperiphery economies (Mohanty and Turner, 2006). Therefore, it has decreased the overall debt pressure and given more room for maneuver to countries and central banks around the world. These two factors imply that reserve accumulation is likely to have decreased the sensitivity. Second, technological innovations are probable drivers of sensitivity. Technological changes, such as the Internet and telecommunications systems, have increased connections between financial markets worldwide. It has enhanced the contagion risk of economic shocks (Markose et al., 2012) and then is likely to have risen the reactivity of central banks to their peers, that is, the sensitivity. The Internet and mobile telecommunications have also increased the speed at which information is disseminated worldwide. Some evidence suggests that these technologies have increased co-movements between financial markets (Veldkamp, 2006a,b), with more fluctuations and specific allocation attentions (Hasler and Ornthanalai, 2018; Mondria and Quintana-Domeque, 2013), both of which have led to more financial spillovers for no change in material economic flows. Third, it is also reasonable that a few elements of the dynamics of financial and

[35]However, some recent empirical estimations nuance the role of inflation targeting in itself (Banerjee et al., 2016; Asab, 2020) and foreign exchange rate regimes in general (Banerjee et al., 2016; Rey, 2015), as having played significant role in isolating monetary areas from external shocks.

[36]Reserve accumulation also stems from specific industrial conditions and the interaction between productivity growth and underdevelopment of the domestic financial market. See Ghosh et al. (2012) for a broader perspective.

trade globalization itself, summarized as economic integration and estimated by the scale factor, have played a key role in changes in sensitivity. In its simplest formulation, this last point indicates that sensitivity can be viewed as a function of the scale factor. Indeed, non-linear and threshold effects caused by the historical dynamics of economic integration may have affected the behavior of central banks, in a context where monetary policy interventions are embedded in the set of macroeconomic policies and political contexts.

Why has sensitivity evolved in this way? For the first period (the 1980s and the early 1990s), three fundamental and intertwined factors can be regarded as major reasons for surging sensitivity: the ending of ISI strategies by semi-periphery countries, the financial openness of core countries, and the development and spread of telecommunication innovations. Firstly, most countries that adopted ISI policies in the post-WWII era had abandoned this strategy by the late 1980s, reducing government intervention, becoming participants in the WTO and opening their financial sectors to international financial flows (for example, see Bulmer-Thomas, 2003, on Latin America).[37] This change toward export-oriented strategies contributed to a rise in the willingness of semi-periphery countries to attract international financial flows as economic development strategy. This pushed countries to adopt monetary policies that accommodate international investors, potentially leading to greater sensitivity to foreign shocks. Secondly, the period was also marked by some important changes in trade costs such as large decreases in air freight charges or container shipping costs (Anderson and Van Wincoop, 2004; Jacks et al., 2008). These effects spurred the integration of the world economy and might have prompted central banks to conduct closer monetary policies in order to attract investors and foster economic development, especially in emerging export-oriented economies. Thirdly, the development of Euromarkets and the loosening of capital control policies by core countries

[37] In a nutshell, ISI strategies were a set of economic policies enacted by many semi-periphery countries from the 1950s to 1980s that advocates replacing foreign imports with domestic production. This is based on the premise that a country should attempt to reduce its foreign dependency through the local production of industrialized products. The impacts of oil shocks and the debt crisis of the 1980s on many semi-periphery countries and the success of the economic development of the four Asian tigers (Hong Kong, Singapore, South Korea and Taiwan) led to an increase in alternative export-oriented economic development strategies.

(e.g., see Helleiner, 1994) created conditions for the development of large international private financial flows during the 1970s and 1980s. For a similar level of economic integration measured by trade connections, the amount of private financial flows capable of changing investment locations worldwide has increased considerably during these decades. This led to major changes in the international monetary system in the 1970s. As the process continued during the 1980s, more pressure was put on central banks by private investors, and we can conjecture that this was a reason for the surge in sensitivity.[38] Fourthly, the growth of global telecommunications networks has dramatically reduced the costs and difficulties of transferring funds and goods abroad. As previously mentioned, the literature supports this interpretation. During that period, these three dynamics sometimes reinforced each other. As an illustration, the UK "Big Bang" in October 1986 was not only important as an opening up of the London Stock Exchange to foreign securities firms (second point), but also a set of huge investments in information technologies (third point) to modernize the City of London (followed by main financial markets and institutions).

The decrease in the sensitivity to peers in the second phase can be attributed to institutional changes and monetary policy strategies by central banks during the period; notably, the rising influence of inflation-targeting strategy, the increase in reserve accumulation to self-insurance against adverse foreign shocks, and the ascendant in central banks' instrument independence.[39] These changes in monetary policies alleviated the impact of the economic integration and the financial liberalization of the previous decades in terms of international monetary policy spillovers. This resulted in a temporary decrease in monetary spillovers. However, these changes were not sufficient to enable complete monetary autonomy in the context of rising economic interdependencies; the spillovers remained high and resumed rising under the pressure of increasing economic integration. Interestingly,

[38]Notably, studies (e.g., Helleiner, 1994) state that fear of losing monetary autonomy due to the development of these international private financial flows was a source of tensions between core countries during the period.

[39]There must have been large overlaps between the effects mentioned to explain the trends between different periods. Indeed, the effects of changes leading to a decrease in sensitivity (e.g., the rise in reserve accumulation) have probably started to impact during the phase of rising sensitivity (in the 1980s) but might have been overshadowed by the other above-mentioned factors (e.g., the rise in sensitivity due to new financial openness).

this interpretation enables us to unify the view of those arguing that floating exchange rate regimes enable more domestic monetary autonomy (for example, Obstfeld et al., 2005; Shambaugh, 2004), and that the Mundell trilemma outperforms a capital-control-vs-monetary-autonomy dilemma, those defending the crucial role of reserve accumulation as a factor that decreases the exposure to international shocks (Aizenman et al., 2016; Aizenman, 2013; Aizenman et al., 2010), and those regarding economic globalization as having led to a loss of monetary autonomy and morphed the trilemma into a dilemma (e.g., see Rey, 2015, and subsequent publications). These changes in monetary policy strategies by central banks can then be regarded as a set of endogenous adjustments by central banks to the adverse rising sensitivity of the 1980s and the continuous economic integration that caused a surge in international monetary policy spillovers. Finally, the ending of the effects of these major changes characterizing this learning-by-doing and/or adjustment process by central banks can have led to a flat trend in sensitivity during the 2010s. We can also conjecture that the last period has been marked by rising monetary cooperation after the GFC, which has led to a rising reactivity of central banks to their peers' monetary condition, counterbalancing the continuous effect of the adjustment of monetary policy strategies by central banks. This effect can be one of the reasons for the stabilization and slight rise in sensitivity in the 2010s, relative to the declining trend of the 1990s and early 2000s.

4.3.3 Robustness analysis

This section briefly discusses three series of robustness exercises: the assessment of a potential sample bias, the effects of including inflation into the model, and the impact of the inclusion of China. These outcomes suggest that the results shown in Figure 4-2 are robust.[40]

[40] A few other robustness checks mentioned in Section 4.2 were performed (e.g., based on the use of monetary policy rates rather than the shadow rates). As a complement, simulation results obtained based on an alternative statistical estimation procedure (relying on the generalized autoregressive score-driven framework, as in Blasques et al. (2016b)), using different data to build the spatial weighting matrix W_t, and for different metaparameters (e.g., the bandwidth) are provided in Appendix C.6.

The results concerning the increasing sensitivity in response to international monetary policy spillovers are robust to the sample specifications. To test the existence of sample bias in our core results as well as to provide additional details on geographic characteristics, we define six additional samples, called Sets 2 to 7 (Set 1 as the baseline sample). These samples include additional countries and are the result of a trade-off between data availability and an attempt to aggregate different sets of countries based on geographical proximity. Samples are such that countries in Set N are included in Set $N-1$, and the time span of Set N is shorter than Set $N-1$. What matters the most is that (i) Set 3 is an extension of Set 2, which includes six Asian countries, (ii) Set 4 includes seven countries from the Eastern bloc (therefore, it follows the collapse of the USSR), (iii) Set 5 incorporates a few Latin American and Middle Eastern and North African (MENA) countries, and Set 7 includes 75 and starts in 2001.[41]

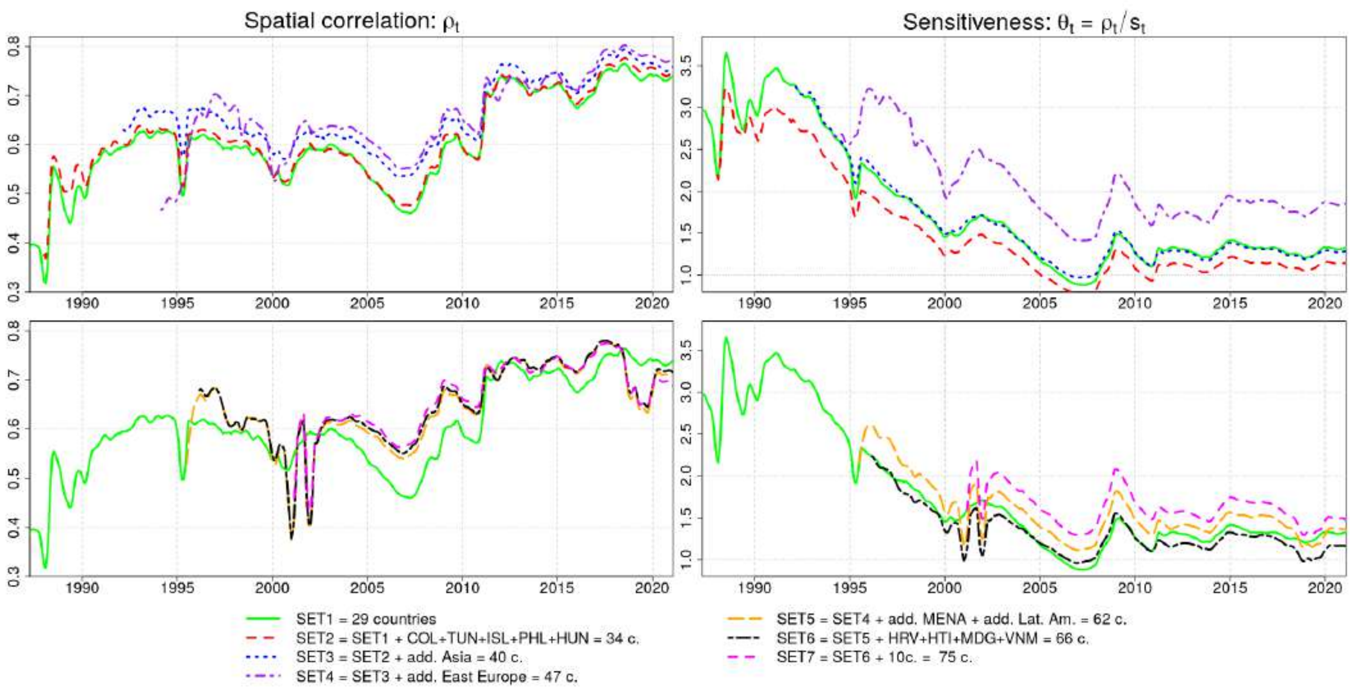


Figure 4-3: Spatial dependence parameter and sensitivity for different sets of countries

The left-hand panels show estimates of the spatial dependence parameter, ρ_t for the seven different samples. The right-hand panels exhibit the sensitivity, θ_t. In every case, the scale factor, s_t, is very close to values display in Figure 4-2. Details on the composition of each set of countries are reported in Appendix C.1.

[41] Details on the compositions and time spans of each sample are reported in Table C.1, in Appendix C.1.

Figure 4-3 displays the estimation results over these seven samples, which are in line with previous interpretations and tend to confirm that the spillovers are sizable and substantially increased over the last four decades. Overall, the increasing and decreasing trends of the LKSR estimates happen during the same periods in all samples, except only a few shocks. The sensitivity factor decreased during the 1990s and early 2000s, reaching a low peak around 2007-2008. The sensitivity rose in the aftermath of the GFC and has subsequently stabilized, varying around a flat trend. In general, these shorter-sample-based results suggest that the baseline scenario results are robust and that monetary areas have partially lost their monetary policy autonomy through their economic integration.

Six distinctions between these simulations and the baseline results are worth discussing:[42]

1. The baseline results show a decrease in the intensity of international monetary spillovers at the end of 1994 and beginning of 1995. When the sample is expanded to include more countries (Sets 2 and 3), we observe that this drop is not as large. One likely explanation could be that Mexican and Lebanese interest rates peaked to very high levels at that time (and to a lesser extent, in Algeria and Ghana). The inclusion of other countries in the sample "dilute" this effect and the drop becomes less severe.

2. The inclusion of countries from the Eastern bloc in Set 4 leads to a large decrease in the measure of monetary spillover intensity in 1994 and 1995. This is because, during the "transition to capitalism," these countries experienced large financial disruptions and their interest rates were extremely high. This implies that their interest rates were less affected by their connections with their neighbors and more affected by their geopolitical and economic transformations. This particularly concerns Uzbekistan, Ukraine, Kazakhstan, Belarus, and Russia.

3. Large fluctuations appeared in the early 2000s when Latin American and MENA

[42] These points are the conclusions of the scrutiny of the interest rates in the samples.

countries were included. These are due to the very large interest rates in Argentina and Turkey during the period that act as outliers in our data for the period.

4. The decrease in the intensity of international monetary policy spillovers between 2003 and 2008 was lower when the sample size increased. This may suggest that the impacts of the growing subprime bubble in the US were particularly large on the monetary policies of the core economies included in Set 1. This change was particularly marked by the inclusion of Asian countries in the sample. We can conjecture that these countries followed the US monetary policies more closely after the Southeast Asian crises and that the monetary spillovers of the US were large.[43]

5. Figure 4-3 exhibits a drop in international monetary policy spillovers in around 2018 when Sets 5, 6, and 7 are included. As for point 3, this is likely caused by the high interest rates in Latin American and MENA countries. Indeed, Argentina, Yemen, Egypt, Ethiopia, and Turkey all increased their interest rates around 2018 leading to this change in the estimate. We can note that this difference between the estimates of $\hat{\rho}_t$ for Sets 5, 6, and 7 declines in 2020 as many of those countries decreased their monetary policy rates in reaction to the beginning of the COVID-19 crisis.

6. Overall, the intensity of international monetary policy spillovers is slightly higher when the sample is larger, indicating that these spillovers are sizable and the baseline estimates do not seem to overestimate $\hat{\rho}_t$.

When a central bank makes its policy decisions, it takes into account the policy actions of peer central banks, but it almost surely takes account of indicators of domestic economic conditions. Probably the most important domestic factor among them is the level of inflation. We propose then to include a robustness test including the effects of the inflation (as well as inflation-driven spatial spillovers). Therefore, the model becomes $y_t = \rho_t W_t y_t + \beta_t i_t + \lambda_t W_t i_t + Z_t^{-1} \alpha_t \mathbf{1}_n$, where i_t denotes the vector of inflation at time t. We want to

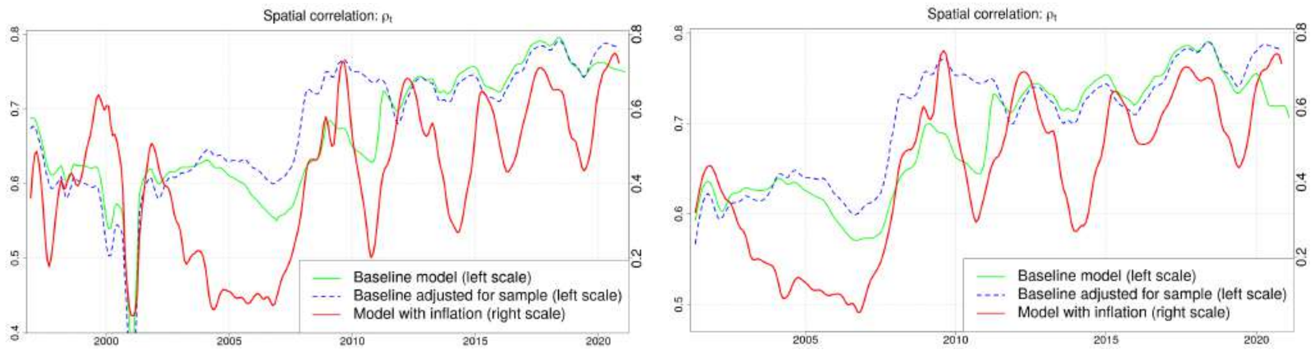
[43]This is corroborated by the rising influence of the US at that time, as measured in Section 4.4.

know how $\hat{\rho}_t$ is influenced by the include of inflation in the model. Figure 4-4 exhibits the estimates of spatial correlation parameters for two samples.[44] Several similarities emerge and confirm our core results. $\hat{\rho}_t$ remains high and of comparable level for most of the periods, confirming the existence of large monetary policy spillovers. The common drops in the early 2000s is due to very large interest rates in a few emerging countries (see point 2 of the discussion above). The average level of monetary spillovers of the post-GFC period is higher than the average level before (without or with the drop before), supporting the previous observations of a rising trends in monetary policy spillovers. Yet, two changes appear when we include inflation effects in the model. The estimates for ρ_t tend to be more volatile. This is partially explained by the rising sensitivity of $\hat{\rho}_t$ to extreme values in this more complex model.[45] Notably, the intensity of the spillovers before the GFC – between 2003 and 2007 – seem to be lower than in the baseline model, while very close afterwards. While in line with the drops observed in the previous figures before the GFC, the decline is more important. This could suggest that the period between 2003 and 2007 could have been characterized by close co-movements and spillovers of inflation. Overall, these estimations indicate that the origin of the spillovers is clearly not entirely driven by the most important domestic driver of monetary policy that is inflation.[46]

[44]Because of data availability for inflation, it was not possible to conduct an analysis for the period before 1995 without substantially reducing the number of countries and then the quality of the estimations.

[45]For example, sharp drops in $\hat{\rho}_t$ seem to be associated with extreme values for inflation, such as measured by the ratio $\max(i_t)/Q_3(i_t)$ - where Q_3 indicates the third quartile.

[46]Other domestic conditions surely impact the policies of central banks (the output gap, foreign exchange rate, unemployment, industrial production, etc.). We do not include these factors for three key reasons. First, we aim at developing a sparse and "agnostic" measure of the interactions between policy interest rates and their evolution over time, and not at developing a overcomplicated model including many confounding effects. Second, it does not seem reasonable to summarize the monetary policies of central banks by regressing their interest rates on domestic factors. A reason is that many countries have changing monetary policy actions. Another is that our samples incorporate large heterogeneities (countries of various stage of developments, size, financial and trade integration, development path, etc.). Then their monetary policies are likely to be influenced very differently by their domestic conditions (for example, some countries' policy rate are poorly correlated to the inflation, which is most conventional domestic factor for this type of models). This exercise of isolating "pure monetary policy shocks" requires a careful analysis on its own. While not incorporating domestic factors can impair our ability to disentangle the origins of the spillovers, a misspecification in the incorporation of the domestic factors would lead to incorrect results. Third, our analysis relies on the access of long-term (ideally monthly) data for a large number of countries. Including more domestic factors would imply two contradicting consequences: a substantial drop in the number of countries (due to data availability) and an increase in the need for more countries to obtain an accurate estimate (given the adding complexity of the model and the spatial nature of the estimate - e.g., the need for a sufficiently large transmission channel matrix



(a) subsample of Set 6 (58 countries) (b) subsample of Set 7 (66 countries)

Figure 4-4: Estimates with a model including the effects of inflation

The inclusion of China in the sample is a major point of interest. China is a major trade player, which may alter the evolution of our results. Indeed, the share of China in international trade has significantly increased in the last 20 years, accounting for nearly 15 % of the total today. However, some factors require caution. First, China is absent from most samples of papers working on monetary policy rules.[47] The main explanations lie in the quality and time spans of data on Chinese interest rates and the fact that the behavior of China is very specific. Second, Chinese monetary policy may not be comparable to other countries' monetary policies. Chinese monetary policy rate decisions are not solely reflected in the official rates. In this study, we suggest a methodology to unveil general patterns regarding the mutual influence of monetary policy across countries. The estimation of a spatial model assumes that all countries are driven by the same model. However, this assumption is doubtful for China.[48] Third, the currency inconvertibility of the renminbi makes their monetary policies singular, but may also blur the links between finance and trade spheres. After the 1960s, a wide majority of industrialized countries progressively removed their capital controls and adopted floating exchange rate regimes.[49]

W_t). Therefore, this would lead to estimations of poorer quality. These three reasons also explain why the model incorporating inflation is viewed as a robustness test.

[47]In general, they do not include China as such but sometimes Taiwan (e.g., see Aizenman et al., 2011).

[48]We can argue that this is also the case for Bolivia, Iran, Belize and Venezuela. The inclusion of these countries does not change our results. Moreover, their influence on the sample (in terms of trade flows) is not as large and, except for Belize, these countries are not included in the first samples.

[49]In 1974, the US initiated this liberalization trend by removing the capital controls it had introduced in the mid-1960s. The UK followed this trend in 1979. Their actions were copied by other advanced industrial nations in the 1980s and 1990s (Eichengreen, 2019b), making them comparable to our study.

However, China still implements stringent control measures to maintain the renminbi non-convertible. China is certainly a trade giant; however, its impact on international finance is moderate. Therefore, a direct inclusion of China could overestimate the weight of this country in the sample. Fourth, we did not find relevant data on China before the early 1990s. Thus, including China in the sample would lead to a loss of approximately 10 years of data in the baseline results. For these reasons, China was not included in the baseline scenario. However, given the importance of the country, we re-assessed our results by estimating our model on extended samples including China or Hong Kong interest rates.[50] As shown in Figure 4-5, we observe that the main features of Figure 4-2 still hold.[51]

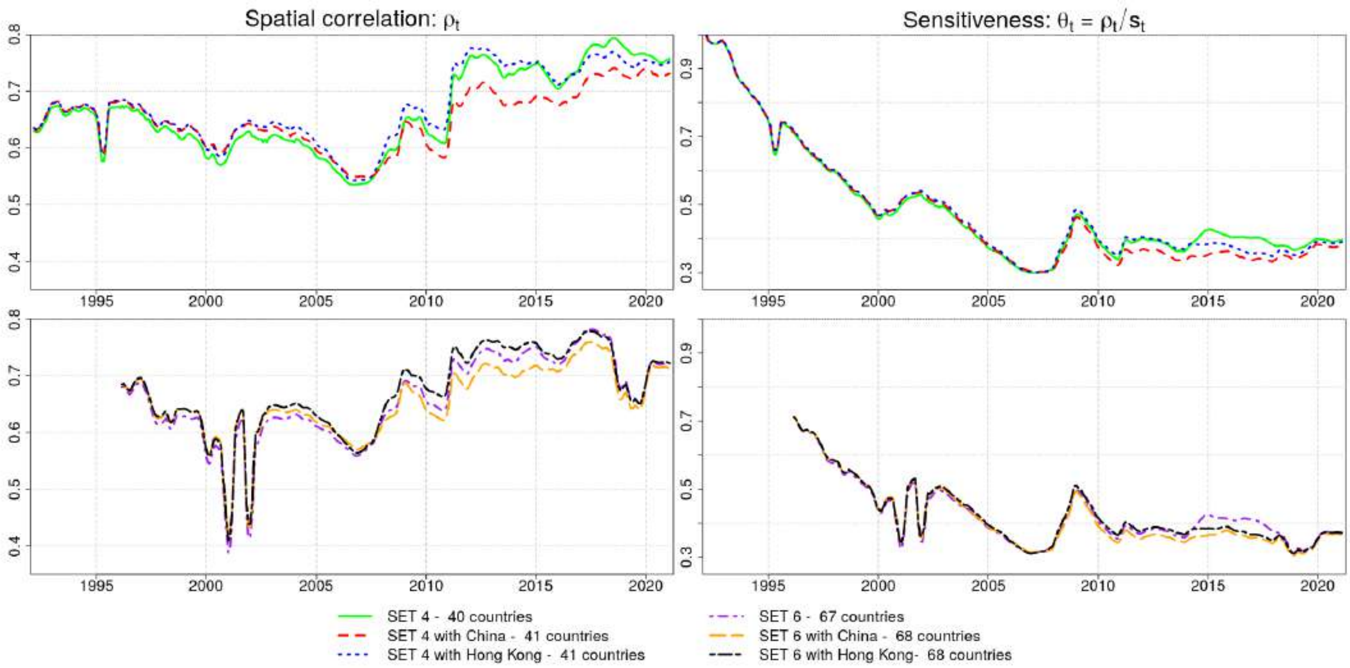


Figure 4-5: Estimates with China and Hong Kong interest rates

Regarding the data used, we have two additional sets of evidence for the robustness of the strategy. First, we tested the use of alternative measures of monetary policy rates. For example, we attempted different shadow rate measures, and the outcome was

[50]In both cases, we used trade connections based on mainland China.

[51]Given the availability of data for China, the samples used started in the 1990s. We can therefore add some additional countries to this robustness check because their monetary policy interest rates are available for these periods. The two samples used to generate Figure 4-5 also contained more countries than the baseline sample. See Appendix C.1 (and in particular Table C.2) for details regarding the samples.

similar to the core results. We also tried alternative representations of the Eurozone (e.g., a GDP-weighted average of interest rates of France, Germany, Italy, and Spain) without finding any significant difference in the results. Second, we assessed the impact of the modeling choices of the transmission channel matrix W_t. We tested the use of an alternative dataset for international trade. Similar results were found for the overlapped periods, with an older NBER dataset covering a shorter sample. Similarly, we used different matrices based on the Comtrade dataset (e.g., only export flows) and found similar patterns. We also considered different spatial weighting matrices based on data on gross bilateral bank financial positions, obtained from the locational banking dataset from the BIS and on bilateral FDI flows provided by Kubelec and Sá (2012). Based on a likelihood comparison, our results indicate that trade connections better fit the data than the FDI flows provided by the Kubelec and Sá dataset (see Appendix C.6.2). Moreover, the pattern of international monetary policy spillovers captured is similar to that of trade connections when we compare overlapping data. The trade-based matrix also performed better than a few geographic-based matrices (e.g., distances between capitals).

4.4 Unipolar vs multipolar spillovers

We further explore international spillovers in monetary policy by documenting the debate on unipolar versus multipolar spillover. This section introduces a test based on the LKSR estimation procedure (see Subsection 4.2.6) and the construction of the spatial weighting matrix W_t to assess the multipolar hypothesis. Several assessments confirm that monetary spillovers result from global interdependencies and are better represented by a multipolar approach. After, we exhibit some evidence suggesting that the influence of US monetary policy on international monetary policy spillovers was particularly important during the decade 2000-2010 but declined afterwards. Finally, we discuss robustness analyses.

4.4.1 Unipolar vs. multipolar debate and identification

To date, two dominant empirical approaches have been used to study international monetary spillover. On the one side, many significant empirical researches on monetary spillovers based their methodology on an *unipolar approach*; meaning that each country's monetary policy is influenced by the monetary policy of another country.[52] In this framework, each country is usually influenced by a base country defined "*as the country that a home country's monetary policy is most closely linked with*" (Aizenman et al., 2008). In most cases, the base countries are the US or the Eurozone.[53] An extreme position consists of taking only one country as the only source of international monetary spillovers. In this scenario, researchers commonly consider the US as the global and unique source of international monetary spillovers (e.g., Breitenlechner et al., 2021; Nsafoah and Serletis, 2019). We call this modeling the *US-centered unipolar approach*. On the other side, recent studies have highlighted the importance of the *multipolar hypothesis*, which asserts that monetary spillovers are the result of global interdependencies and are better represented by a multipolar approach (Dées and Galesi, 2021; Montecino, 2018). This *mutlipolar approach*, also called the network or spatial approach, models international monetary policy spillovers as a result of a complex network of economic connections (e.g., international trade), meaning that a country's monetary policy is affected by a combination of multiple monetary policies from different countries (e.g., trade partners). This method is schematically represented and distinguished from the two main alternative unipolar approaches (US-centered and base-country approaches) in Figure 4-6.

To evaluate the multipolar hypothesis, we consider the DGP defined by Equation 4.3 with a spatial weighting matrix W_t^{γ} substituting W_t. W_t^{γ} is defined as the linear combination of two matrices: W_t^1 and W_t^2. The relative weight is represented by an estimate

[52] We included base-country studies (e.g., Nsafoah and Serletis, 2019; Klein and Shambaugh, 2015; Shambaugh, 2004) and "bilateral" VAR and global VAR studies (e.g., Breitenlechner et al., 2021; Ca' Zorzi et al., 2021) in the unipolar approach. See Subsection 4.1 and Montecino (2018) for further details.

[53] A few base countries include less influential financial centers. For example, it is the case for Australia with New Zealand, India with some neighboring countries, Malaysia with Singapore, and South Africa with some close African countries.

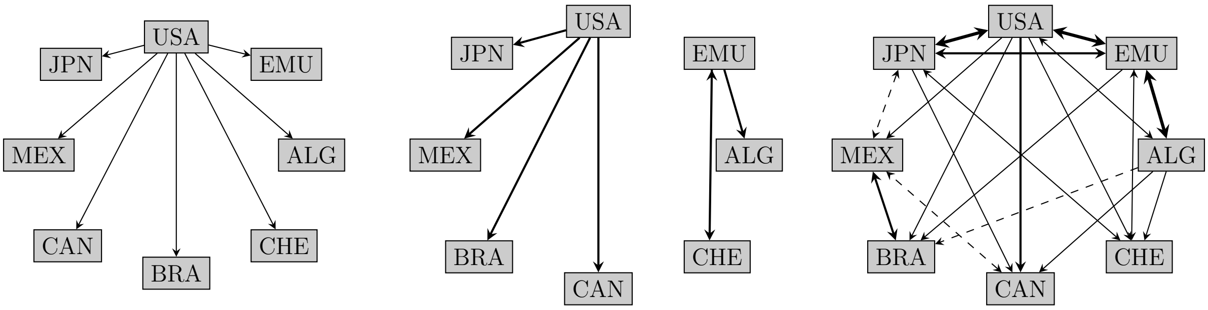


Figure 4-6: US-centered and base-country unipolar approaches vs. spatial multipolar approach

Details on the formal modeling of the US-centered and base-country unipolar approaches in the framework introduced in Section 4.2 are respectively given in Subsections 4.4.2 and C.7.2.

γ, such that $W_t^\gamma = \gamma W_t^1 + (1-\gamma)W_t^2$ with $\gamma \in \{0,1\}$. The sum of the elements of W_t^1 equals the sum of the elements of W_t^2, such that the spatial dependence parameter ρ_t still captures the intensity of the monetary spillovers over time. To determine the optimal parameter γ, we performed a log-likelihood comparison of the models defined by Equation 4.2 with different spatial weighting matrices W_t^γ. Accordingly, the estimate $\hat{\gamma}$ is obtained from the following ML procedure:

$$\hat{\gamma} = \arg\max_{\gamma} L(\gamma) \qquad \text{where} \qquad L(\gamma) = \sum_{t=1}^{T} \log\left[p(y_t \mid W_t^\gamma; \rho_t, \beta_t, \alpha_t, \sigma_t)\right] \tag{4.6}$$

$$W_t^\gamma = \gamma W_t^1 + (1-\gamma)W_t^2 \tag{4.7}$$

where the function p is such that $p(y_t \mid W_t^\gamma; \rho_t, \beta_t, \alpha_t, \sigma_t) = p(y_t \mid \rho_t, \beta_t, \alpha_t, \sigma_t)$ and can be directly derived from Equation 4.5. Therefore, this approach provides a ML estimate of the relative weight between those matrices that better fit the data.[54]

Using this method, we can test the multipolar hypothesis. W_t^1 and W_t^2 represent two different spatial weighting matrices modeling different transmission channels of monetary policy spillovers. With no loss of generality, the unipolar approach can be viewed as a particular case of a more general spatial weighting matrix in which each row contains at most only one strictly positive value (the other values are zero). Therefore, we can redefine

[54] It also enables us to compare various spatial weighting matrices and suggest which better represent the true interactions. Yet a formal likelihood-ratio test is needed to ensure the statistical significance of the results. This test should be implemented in further research.

the unipolar approach in our spatial framework by building an appropriate "unipolar-based" spatial weighting matrix, W_t^1. We can then estimate the relative weight γ between W_t^1 and the trade-based spatial weighting matrix, W_t^2, and test if the data are better represented by unipolar or multipolar monetary spillovers. If the estimated weight of the unipolar-based matrix is high (γ close to 1), this tends to confirm the hypothesis that spillovers exhibit unipolar patterns of interaction, as $W_t^\gamma \approx W_t^1$. Conversely, if the relative weight of the unipolar-based matrix is low (γ close to 0), the multipolar hypothesis seems more representative of the data. In other words, the lower the estimated γ, the greater our confidence is in the multipolar hypothesis.

4.4.2 The multipolar hypothesis and influence of the US

We denote the time-varying international trade spatial weighting matrix defined and used previously to build a indicator of international monetary spillovers by W_t^{multi} (see Subsections 4.2.4). This matrix models multipolar transmission channels. On the unipolar side, W_t^{US} represents a spatial weighting matrix, in which the Fed influences the rest of the world, while no other countries affect the American monetary policy.[55] The spatial weighting matrix W_t^γ is then defined as a linear combination of these two matrices, such that if γ takes a value close to 0 (resp. 1) then the multipolar (resp. US-centered unipolar) approach seems to be a better representation of the transmission channels of monetary policy spillovers: $W_t^\gamma = \gamma W_t^{US} + (1-\gamma) W_t^{\text{multi}}$.

Figure 4-7 reports the values taken by the log-likelihood $L(\gamma)$, defined by Equation 4.6, viewed as a function of γ for the different samples (see Subsection 4.3.3). The log-

[55] More formally, we define W_t^{US} as the US-centered spatial weighting matrix as follows:

$$w_{t;i,j}^{US} = \begin{cases} w_{t;i,j}^{\text{multi}}, & \text{if } j = j_{US}, \\ 0, & \text{else,} \end{cases} \tag{4.8}$$

where j_{US} is the column number associated with the US. For tractability, the proximity to the US is also measured through trade connections. We also considered alternative specifications. As a key illustration, $W_t^{US,01}$ can be defined such that the values are equal to 1 if they are associated with the US and zero otherwise. Results strongly confirm the multipolar hypothesis and $\hat{\gamma}$ is almost always zero. Overall, the model using W_t^{US} fit the data better. The details of the different specifications are available upon request.

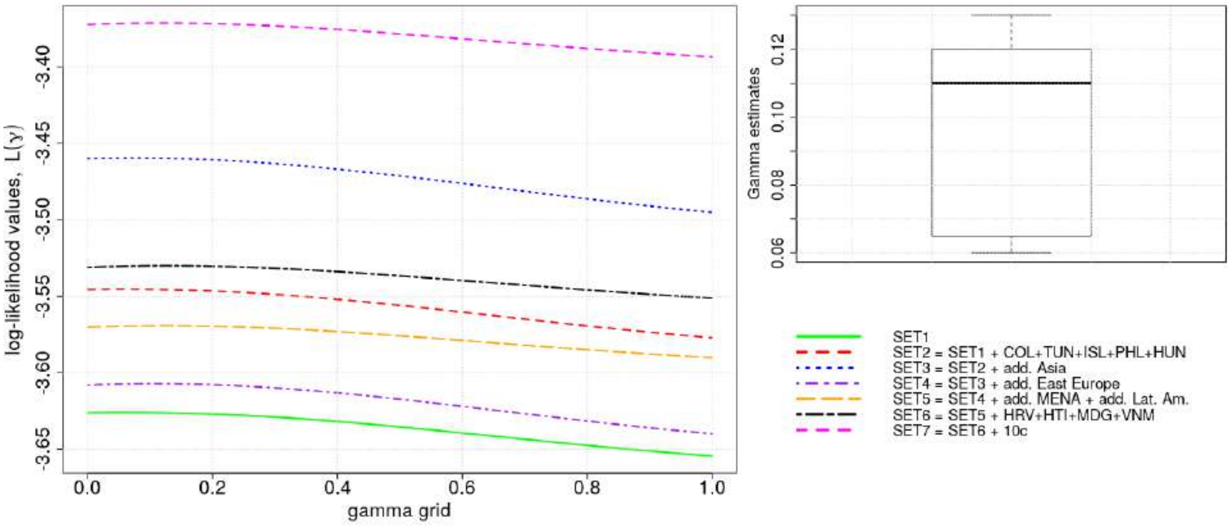


Figure 4-7: US-centered vs multipolar approaches; confirmation of the multipolar hypothesis.

Goodness of fit comparison via log-likelihood values $L(\gamma)$ for the different samples and boxplot of $\hat{\gamma}$ for the different samples; 7 samples; from 1982 to 2021; $W_t^{\gamma} = \gamma W_t^{US} + (1-\gamma)W_t^{\text{multi}}$; increment for the gamma grid of 0.01.

likelihood curves are concave and monotonically decreasing once γ is higher than values around 0.1. It is then reasonable to consider that $\gamma \approx 0.1$. More specifically, we observe that $\hat{\gamma} \in [0.06\,; 0.13]$, depending on the sample considered. In each case, we have $L(\gamma = 0) > L(\gamma = 1)$. These results tend to support the multipolar hypothesis and the implementation of spatial techniques to measure international monetary policy spillovers.[56]

In addition to testing the multipolar hypothesis, we examined whether the influence of the Fed has varied over time. To assess this, we decompose the period from 1982 to 2021 into seven sub-periods of around five years and seven months each and reproduce the same estimation procedure for those sub-periods.[57] This decomposition in sub-periods enables us to assess the evolution of the US monetary singularity over key historical events. The first and third sub-periods cover many financial crises in emerging economies (e.g.,

[56]Relying on the hypothesis that the likelihood ratio test statistic $(-2\,[L(\gamma=0)-L(\gamma=1)])$ for the null hypothesis ($H_0 \equiv \gamma = 0$) converges asymptotically to being χ^2-distributed, the estimation results suggest that we reject the null hypothesis. Specifically, the associated p-values for such hypothesis tests are lower than 1 % for every tested scenario (e.g., different samples, different modeling of W_t^{US}).

[57]The sub-periods are (i) January 1982 to July 1987; (ii) July 1987 to February 1993; (iii) February 1993 to September 1998; (iv) September 1998 to April 2004; (v) April 2004 to November 2009; (vi) November 11-2009 to June 2015; and (vii) June 2015 to March 2021.

the debt crisis, including Mexico in 1982, the tequila crisis in 1994, the Asian crisis in 1997-1998, the Russian crisis in 1998). The dot-com bubble was included in the fourth sub-period. The fifth sub-period spans from the development of the housing bubble to the direct aftermath of the GFC. The end of the last sub-period covered the beginning of the COVID-19 crisis. The estimates of γ_t and ρ_t for each sample and sub-period are shown in Figures 4-8.(a) and (b).[58] We observe that the estimates $\hat{\rho}_t$ are very close to the above displayed in Figure 4-3, that is for $\gamma = 0$. This confirms that these estimates are robust and capture the intensity of international monetary spillovers.[59]

Estimates of the relative weight of US monetary policy, also called the singularity of the US, $\hat{\gamma}$, varies over time; taking values between 0 and 0.4. During the three first periods, $\hat{\gamma}$ is very small and close to 0. It rose importantly around the turn of the millennium and even further with the GFC. This suggests that the Fed was more prevalent in the 2000s than in the 1990s. The low level of $\hat{\gamma}$ in the 1980s and 1990s can be ascribed to financial crises in emerging economies that led them to adopt monetary policies closer to a few of their emerging trade partners and more distinct from the US relative to the next decade (e.g., during the South East Asian financial crisis). Likewise, the rise in the importance of the US economy during the sub-periods from 1998 to 2004 could be due to relative financial stability worldwide. The development of the dot-com and housing bubble in the US and the importance of the US as liquidity provider in the aftermath of the GFC may also have been factors increasing the significance of the US monetary policy between 1998 and 2010. The two most recent sub-periods indicate a decrease in the values of $\hat{\gamma}$. This suggests that the singularity of the Fed in term of monetary policy influence on their

[58] For the first two sub-periods, these estimates $\hat{\gamma}$ can only be built with the two smallest samples in terms of the number of countries (sets I and II). These estimations were made with the smallest spatial weighting matrices and incorporated fewer alternative scenarios. They are then viewed as less robust and reliable than estimates for other subsequent sub-periods, particularly because the identification here relies on the possibility of distinguishing different matrices and then requires as large matrices as possible.

[59] The scale factor and sensitivity are not displayed because the values are very close to the previous estimates. Indeed, estimates $\hat{\rho}_t$ are very close to the above ones for $\gamma = 0$. The sums of the elements of the spatial weighting matrices W_t^{γ} are independent of γ given the normalization procedure used for W_t^1 and W_t^2. Therefore, any relevant measure of economic integration would necessarily be very close to previous ones. Accordingly, because $\hat{\rho}_t$ and $\hat{s}_t$ exhibit the same pattern as in Figures 4-2 and 4-3, the sensitivity θ_t is also very close to the previous estimates for $\gamma_t = 0$ (see Figure 4-3).

neighborhood has diminished since the GFC.

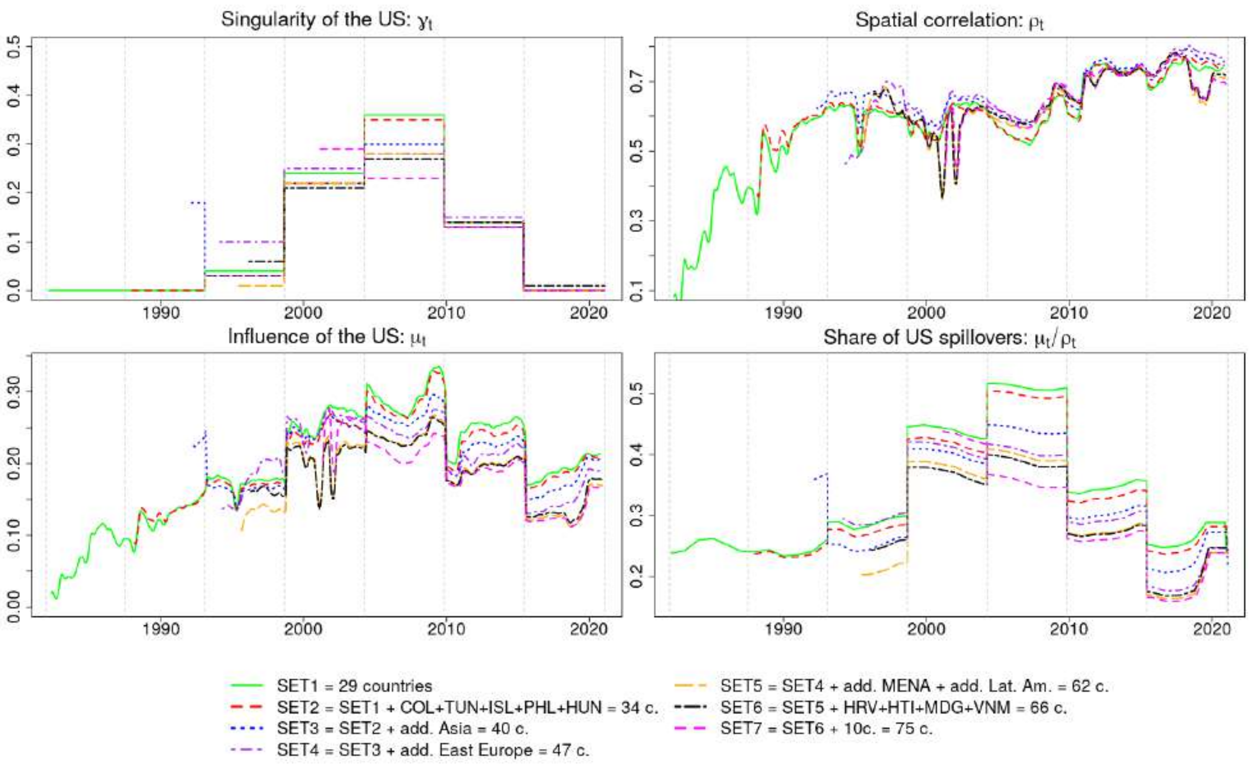


Figure 4-8: Rise and decline in the US singularity and influence on monetary spillovers. Estimates of the US singularity, γ_t, and US influence, μ_t, on international monetary spillovers on the top-left and bottom-left panels respectively. The top-right panel displays the spatial dependence parameter ρ_t. The bottom-right panel exhibit the estimates of the share of international monetary policy spillovers due to the US, μ_t/ρ_t. Details on estimation: from 1982 to 2021; $W_t^{\gamma} = \gamma W_t^{\text{US}} + (1-\gamma)W_t^{\text{multi}}$; seven samples; seven sub-periods; increment values for γ of 0.01.

Importantly, small (resp. smaller) values of γ do not necessarily indicate a low level (resp. a loss) in the *absolute* influence of the US monetary policy. Rather, it indicates a low level (resp. a loss) of global influence of the US *relative* to other countries (mainly those with important trade connections), relative to their trade influence. In other words, γ is an indicator of the US monetary singularity in the sense that a high γ signals a higher influence of the US monetary policy on others than its influence measured by international trade, and not of the global influence of the US. To better understand this distinction, we define an indicator, noted μ_t, that assesses the direct global absolute influence of a change in US monetary policy interest rates, Δy_t^{US}, on other interest rates, $\sum_{\forall j \neq j_{US}} \Delta y_t^j$, by the following expression:[60]

$$\mu_t \;=\; \rho_t \frac{\left(\gamma_t \sum_{\forall i,j} w^{US}_{t;i,j} + (1-\gamma_t)\sum_{i=1,j=j_{US}}^{n} w^{\text{multi}}_{t;i,j}\right)}{\sum_{\forall i,j} w^{\text{multi}}_{t;i,j}}. \tag{4.9}$$

Based on this equation, the ratio μ_t/ρ_t represents the share of international monetary spillovers due to the US monetary policy.[61] Consistently, the intensity of international monetary spillovers, ρ_t, acts as an upper-bound level for the intensity of international monetary spillovers caused by the Fed, μ_t; $\mu_t \leq \rho_t$. Accordingly, the influence of the US can increase because either or both of the intensity of monetary spillovers increases, $\frac{\partial \rho_t}{\partial t} > 0$, and/or the share of those spillovers due to the US increases, $\frac{\partial(\mu_t/\rho_t)}{\partial t} > 0$.[62]

Estimates $\hat{\mu}_t$ and ratios $\hat{\mu}_t/\hat{\rho}_t$ are exhibited in Figure 4-8, respectively in Charts (c) and (d). We see that while $\hat{\gamma}_t$ is very close and quite stable between 1980 and 2000, the influence of the US monetary policy on other countries steadily and strongly increased over that period. This is due to a stable share of the spillovers ascribed to the US, the ratio μ_t/ρ_t, of around 25 % along the two decades, and a massive rise in the overall intensity of international monetary spillovers, with an increase from 0.1 to approximately 0.6 of $\hat{\rho}_t$. Later, the singularity of the US, measured by $\hat{\gamma}_t$ was very high and the share of spillovers due to the US peaked to 50 % around 2008. This suggests that the monetary influence of the US, $\hat{\mu}_t$, rose despite a small decline in international monetary spillovers, $\hat{\rho}_t$, over that period between 1995/2000 and 2008. After 2010, we observe a opposite trend with a rise in international monetary spillovers, $\hat{\rho}_t$, but a decrease in the influence of the US monetary policy, $\hat{\mu}_t$. Empirical results for this last period indicate that this has been caused by a decline in the singularity of and the share of spillovers caused by the US, respectively approximated by $\hat{\gamma}_t$ and $\hat{\mu}_t/\hat{\rho}_t$.

[60]We specify "direct" because spatial models allow multiple feedback loops (see Subsection 4.2.2). For simplicity, we do not include these effects in the definition of μ_t and only include immediate spillovers.

[61]Here, we assume equal variation in interest rates for each country so that the influence of a monetary area on others is due to the transmission channel structure (defined here by ρ_t and W^{γ}_t). The remaining monetary spillovers (which are not included in μ_t) are given by $\bar{\mu}_t = \rho_t(1-\gamma_t)\left(\sum_{i=1,j\neq j_{US}}^{n} w^{\text{multi}}_{t;i,j}\right) / \sum_{\forall i,j} w^{\text{multi}}_{t;i,j}$. Therefore, we obtain the following relationship: $\rho_t = \mu_t + \bar{\mu}_t$.

[62]The links between γ_t and μ_t are discussed in Appendix C.4.2.

A few possible reasons for this decline in the US monetary influence may be suggested at this stage. The period around the GFC coincides with the apex of the influence of the US. It is unlikely that this simultaneity is a simple coincidence. It is then possible that the financial attractiveness resulting from the US housing bubble led to a larger influence, albeit temporary, of the Fed on global financial transactions. In such scenario, the hump-shaped curve obtained for γ_t could be due to this dynamics so that the decline in the US these recent years might actually be the counterpart of an "artificially" high influence around 2008. The diminishing impact of the US on monetary matters in recent decades can also be attributed to a number of macroeconomic factors. The US has experienced a relative decline in economic power in recent years (notably due to the rise of emerging economies). Other central banks might have become more important players in the global financial system, and their policies may have had a more significant impact, as a simple result of the economy growth of their economies.[63] Another factor has been the decline in the US dollar's share of global currency reserves, which has fallen from over 70 % in the 1990s to around 60 % today.[64] Other structural factors may have played a role as they might have induced rebalancing effects in the global economy. The greater degree of financial integration made it more difficult for any single country to dominate the global financial system. In 2001, the total foreign exchange market turnover was USD 1.2 trillion, while in 2019, it was over USD 6.6 trillion, indicating a significant increase in the size and complexity of financial markets. In addition, interest rate differentials are significant drivers of international financial flows. With the decline in global interest rates, the impact of these differentials might have diminished and with it the influence of the large center economies.[65] Reserve accumulation by emerging countries might have decreased the influence of the Fed on these countries because it has allowed them to

[63]For example, the GDP of the US as a share of the world GDP declined since 2000 where it peaked around 30 %. It is now close to 24 %. This shift in economic power can partially explain the decrease in the influence of the Fed (with a lag).

[64]Importantly, based on various metrics, the US dollar remains by far the most influential currency in the global economy.

[65]For example, in 2001, the US federal funds rate was around 3.5 % higher than the euro area's main refinancing rate, while in 2021, the difference was less than 0.5 %.

build a buffer against external shocks, reducing their dependence on external financing.[66] Likewise, several countries have moved towards inflation targeting in the last two decades as a means of maintaining price stability domestically, reducing the reliance on exchange rate stability (to the US dollar) as a policy goal.[67]

4.4.3 Robustness analysis

To provide additional evidence confirming the multipolar hypothesis and the increasing multipolarity of international monetary spillovers after 2008, we tested three additional alternative matrices W_t^1 against $W_t^2 = W_t^{\text{multi}}$, as developed in Subsection 4.4.1. These three scenarios hinged on the dominance of a few major monetary actors (notably, the ECB and the Fed). The first is the base-country model schematized in Figure 4-6. The second scenario consists of modeling the Fed, the ECB, the BoE and the BOJ as the four main monetary policy institutions that influence other monetary policies. The third scenario is to suppose that core countries influence others: semi-periphery and periphery countries.[68] The main features hold in these different configurations, confirming our results, particularly the multipolar hypothesis. Moreover, it indicates that not only the Fed but also other major Western monetary institutions had a rising influence on foreign monetary policies between 1995 and 2010 while their influence decreased after the GFC.[69]

Three additional sets of robustness checks were performed to corroborate the results, in particular the multipolar hypothesis. First, we use seven samples composed of different sets of countries covering different periods (similar to the results on international monetary spillover estimates of Subsection 4.3.1). Figures 4-7 and 4-8 show the results for these samples. All other assessments were performed using these seven samples. In all the tested specifications, the results were robust and close to each other. Second, we estimated γ_t

[66] According to data from the IMF, the average reserves-to-GDP ratio in developing countries more than doubled between 1980 and 2020, increasing from 8 to 21 %.

[67] These points imply that these factors may have contributed to a decline in the influence of the Fed more important than the influence of other economies (for example, neighboring economies). Further research is needed to confirm or infirm these hypotheses.

[68] The list of base and core countries is given in Appendix C.1.

[69] The details of these tests and their results are reported in Appendix C.7.2.

based on additional sets of subperiodization other than the seven sub-periods introduced in Subsection 4.4.2. On the one hand, longer sub-periods enable the assessment of γ_t with less variation between the estimates (for example, between different samples) but provide less detailed temporal information. On the other hand, shorter sub-periods improve the temporal accuracy but imply larger fluctuations of the estimates $\hat{\gamma}$ and more sensitivity to changes in the samples. The seven samples used as benchmarks represent a trade-off between these two directions. In our simulations, the trends shown in Figures 4-7 and 4-8 are robust to changes in subperiodization. Third, an alternative measure of "unipolarity" is the metaparamter k which indicates the number of nearest neighbors that are allowed to influence each country.[70] Indeed, on the one hand, $k = 1$ implies that each country is impacted by the interest rate of only one other country. This is a specific case of a unipolar approach. On the other hand, $k = n$ or $k \gg 1$ indicates a high level of multipolarity. Based on ML estimation, the results suggest that the optimal value of k is 15, and the log-likelihood drops quickly when k is below 13. This result confirms the multipolar hypothesis.[71]

4.5 Summary of empirical results

A summary of our main empirical results is shown in Table 4.1. We see that changes in international monetary spillovers and US monetary influence can be approximately outlined by different trends during three main periods.

The first period included transformations in the 1980s and the early 1990s. At the beginning of the 1980s, international monetary spillovers seemed to have been weak ($\hat{\rho}_{t=1982} \approx 0.1$), yet the decade is marked by large economic integration ($\hat{s}_t$ doubled). Moreover, between 1982 and 1987, this period of economic globalization was also characterized by a large rise in the sensitivity of central banks to foreign monetary policies

[70]This metaparameter was used to assess the robustness of our core results, as mentioned in Subsection 4.2.6.

[71]See Figure C-11 in Appendix C.6.2 for details. In addition, we can mention that the singularity and influence of the US, γ_t and μ_t have been estimated using different bandwidths and kernel functions. In all cases, the results were very similar to those displayed in Figures 4-7 and 4-8.

Effects	Symbols	1980–1995/2000	1995/2000–2010	2010–2021
intensity of spillovers	ρ_t $\frac{\partial \rho_t}{\partial t}$	from 0.1 to 0.6 +++	around 0.6 0 / −	around 0.7 ++
scale factor	s_t $\frac{\partial s_t}{\partial t}$	large integration ++	large integration ++	integration, + volatile +
sensivitity to peers	θ_t $\frac{\partial \theta_t}{\partial t}$	∩-shape +++ ⇒ − −	declining − −	stable/small rise 0 / +
US monetary singularity	γ_t $\frac{\partial \gamma_t}{\partial t}$	very low, close to 0 0 / +	medium, around 0.2-0.3 ++	low, around 0.1 − −
US monetary influence	μ_t $\frac{\partial \mu_t}{\partial t}$	low, from 0.05 to 0.15 ++	large, around 0.25 ++	medium, around 0.15-0.2 − −
share of spillovers due to the US	μ_t/ρ_t	around 25/30 %	around 40/50 %	around 20/30 %
summary of the period		low to medium spillovers large rise in spillovers rise followed by a fall in sensitivity large importance of the US	large and stable spillovers decline in sensitivity very large and rising importance of the US	large and rising spillovers slow rise in sensitivity declining importance of the US

Table 4.1: Summary of empirical results for the three main periods.

($\hat{\theta}_t$ was multiplied by four). While the globalization process continued and even accelerated in the 1990s, monetary policy sensitivity to peers began to decline at the end of the 1980s. The combination of these factors led to a massive increase in international monetary policy spillovers in the 1980s. By the beginning of the 1990s, the declining sensitivity was compensated by rising economic integration, such that monetary spillovers peaked in 1992-1993 (at that time, $\hat{\rho}$ reached a local maximum value of approximately 0.6). During the entire period, the influence of the US was stable and large. The Fed accounted for approximately a quarter of all monetary spillovers.

The second period spans from the mid-1990s to around 2010, namely, from the disruptive financial crises in emerging countries in the 1990s to the aftermath of the GFC. This period is characterized by two main trends: the continuous decline in sensitivity of central banks' policies to their peers ($\hat{\theta}_t$ dropped by a factor of four between the late 1980s and the mid-2000s) and the enhancement of the monetary policy influence of the US. The first result could be ascribed to different changes in monetary policies around the world (rising importance of more flexible parity regimes and inflation-targeting monetary policies in the 1990s, as well as other transformations such as the beginning of reserve accumulation by a few emerging economies). These changes can be regarded as a general learning-by-doing process that central banks went through during this period. Overall, the decline in sensitivity overtook the economic integration process. This resulted in a decrease in international monetary spillovers, up to the GFC. The second result, the growth of US influence is primarily due to transformation in transmission channels;[72] The monetary singularity of the US, estimated by $\hat{\gamma}_t$, rose from almost zero to around 0.3 while its influence, assessed by μ_t, increased from 0.15 to 0.3. This led to a rise in the US monetary influence during a period of declining spillovers and a stable share in international trade. Given the subsequent drop after the GFC and the centrality of the US, we can conjecture that this trend was due to the large financial flows triggered by the boom and bursting of the subprime bubble in the US.

[72] Generally, this can be ascribed to major central banks (see results reported in Appendix C.7.2).

The results indicate that the last decade represents the last period of changes in international monetary policy interdependencies. This period is characterized by spillovers of very high intensity ($\hat{\rho}_t \approx 0.7$) and a fall in the influence of US interest rates ($\hat{\mu}_t$ dropped from around 0.25 to 0.15). The return to growth of monetary spillovers is primarily caused by the halt in the decline in the sensitivity to peers of central banks ($\hat{\theta}_t$ rose in the aftermath of the GFC and has maintained its value since). Following the same reasoning as before, this may be because economic integration has continued (despite some disruptions and more volatility since the GFC), while central banks had already integrated major institutional transformations required to alleviate the domestic impacts of globalization during the previous periods. We can also conjecture that the change in the sensitivity trend is due to the rising coordination of monetary policies by major monetary policy institutions. The decrease in the US influence over time is very large but should not mask the continuous global importance of the Fed (our estimates imply that approximately 20%–30 % of international spillovers are due to the US).[73]

4.6 Conclusion

We propose a new model to estimate the time-varying spatial dependence coefficient ρ_t in panel datasets based on spatial regressions and semi-parametric local kernel models: the LKSR procedure. The spatial weighting matrix W_t used to model the transmission channels is time-varying and based on international trade flows. Based on this approach, this study documents the existence of sizable international monetary policy spillovers across monetary areas that have risen considerably over the last four decades. The magnitude of these spillovers suggests that they represent significant threats to the achievement of the domestic objectives of monetary policy authorities. Therefore, the results suggest that countries have partially lost their monetary policy autonomy through economic integration.

[73] It is worth noting that, based on the results obtained, the COVID-19 crisis does not seem to have created a disruptive change in international monetary policy spillovers (even if some estimates for the large samples indicate a drop of around 0.1 in the spatial dependence parameter).

We show that it is possible to disentangle international monetary policy spillovers induced by the intensification of globalization (the scale factor, s_t) from peers effects; that is, the sensitivity of monetary policy decisions in response to other central banks' policies at a given integration level (the sensitivity factor, θ_t). Sensitivity to foreign monetary policies rose considerably during the 1980s. Between 1990 and the GFC, this sensitivity slightly decreased to reach a flat trend close to its initial value of the early 1980s. In addition, we find that international monetary policy spillovers are better modeled by multipolar interconnections than by a dependence on the Fed monetary policy. Overall, the results suggest the existence of a multipolar rather than unipolar system of central bank decisions. We also show that the US interest rate was a major source of monetary spillovers in the 2000s. However, since the GFC, the influence of the Fed seems to have decreased.

5 | General Conclusion

This last chapter highlights my core findings, discusses the limitations of the research, and provides an outlook on future work.

The last 50 years have been characterized by the re-emergence of highly interconnected financial markets, the rise in international financial interdependencies, the surge in international financial flows, the generalized abandonment of capital control policies in the center (e.g., see Helleiner, 1996; Burn, 1999; Obstfeld and Taylor, 2005; Eichengreen, 2019a). Likewise, the period was characterized by a upsurge in intercontinental volume of trade, price convergences in commodity markets, numerous trade agreements and tariff reductions, the internationalization of the production processes, the rising dominance of MNEs as well as a massive reduction in transport costs (e.g., see Findlay and O'Rourke, 2003; Kepaptsoglou et al., 2010; Fitzgerald, 2015; Arvis et al., 2016; Bethlehem et al., 2022). These transformations of the global economy have inevitably affected the conduct of monetary policies as well as the effectiveness of such policies.

Chapter 1 documented some of the key channels through which economic globalization impacted central banks' monetary policies. This introduction showed how vast and complex the interaction between globalization and monetary policy is. In this context, Chapter 2 proposed to complement the literature by adding an additional channel of interaction. Based on Borio (2014), it argues that economic globalization contributed to accentuate the magnitude of medium-term cycles in center economies, in particular financial cycles. This study provides data-based empirical evidence of the countercyclicity between medium-term cycles in center leader countries and financial inflows to semi-periphery countries. A large global factor seems to play a dominant role in this channel. In addition, financially linked semi-periphery economies seem to suffer more of the countercyclical dynamic while trade connected semi-periphery countries tend to experience procyclical financial inflows. Chapter 3 extended the previous study by analysing how large medium-term cycles in center leader countries had considerably impacted semi-periphery countries by affecting the international macroeconomic conditions in which they must operate. In particular, the analysis suggested that the cyclical pattern in international financial flows highlighted in Chapter 2 is a major driver of financial balance-of-payment distresses in semi-periphery economies, and as a consequence, of a loss of financial and monetary control at a domestic level. Chapter 4 tackled the issue of the connection between economic globalization and monetary policy autonomy through a different approach. Without relying on explicit channels of interaction, the study documents that international monetary policy spillovers increased these last four decades. Importantly, the study also suggested that economic globalization – measured or proxied by international trade connections – is more likely to be the source of such rising spillovers, in contrast to central bank sensitivity. This has important implication as it indicates that central banks' conducts of monetary policy have become more interdependent over time and suggests a potential loss in room of manoeuvre by monetary authorities (assuming an unchanged monetary policy effectiveness).

5.1 Medium-term cycles and financial flows

Chapter 2 by provide theoretical and empirical foundations on the existence and nature of a pattern of cyclical international financial flows to semi-periphery economies driven by medium-term cycles in major center countries that started in the 1970s. Specifically, this chapter addresses the following questions: Do global investment strategies by center countries' investors induce large cyclical international financial flows to semi-periphery countries? and if so, are these financial flows procyclical or countercyclical to the CLIF cycles? Are more integrated semi-periphery economies more impacted than less integrated ones? Does this dynamic concern all types of financial flows? Are periphery countries influenced in a similar manner than semi-periphery countries?

The influence of large economies on rapid changes in international financial flows has drawn attention from academic literature (e.g., Fofack et al., 2020; Shim and Shin, 2021; Matsubayashi and Kitano, 2022), monetary authorities (e.g., Board of Governors of the Federal Reserve System, 2022; ECB, 2021), and international financial institutions (e.g., BIS, 2021; IMF, 2021). In this regard, it has been shown that global factors (or shocks) have had important effects on financial flows to and economic activity in semi-periphery economies (e.g., Miranda-Agrippino and Rey, 2015; Obstfeld et al., 2018; Dées and Galesi, 2021; Davis and Zlate, 2022). In addition, global financial liberalization that started in the 1970s in advanced economies led to large and more synchronized medium-term cycles (Zelazowski et al., 2016; Jordà et al., 2017). Yet, the impact of medium-term cycles in major center economies on patterns in international financial flows to semi-periphery economies has received limited attention.

First, a portfolio optimization model discusses how adjustments by international investors to macroeconomic medium-term cycles contribute to generating a cyclical pattern in international financial flows to semi-periphery countries. The search for short-term yields by international investors encourages them to allocate a larger share of their funds to semi-periphery economies during periods of low profitability in center countries (i.e., the downward phases of medium-term cycles). This effect called the substitution is then contrasted to the volume effect, that is the rise of financial funds invested in the global economy. The substitution effect is therefore prone to lead to periods of large financial inflows to semi-periphery countries that are countercyclical the CLIF cycles and the volume effect is likely to affect procyclically these financial inflows. An estimation strategy is deduced from the theoretical model. Relying on weak assumptions, an identification strategy is designed to empirically test key hypothesis regarding the impacts of the CLIF cycles on international financial flows to semi-periphery economies. Then, based on the methodology introduced in Drehmann et al. (2012) and Borio (2014), a method is proposed to build empirical indicators of the financial and industrial medium-term cycles for the US, Japan, Germany, France, and the UK. In addition, using different networks of interaction between countries, the study tested the importance of financial, trade, and geographical proximities with the center economies.

The empirical findings confirm a few key empirical hypotheses. First and foremost, the medium-term cycles in center economies tend to promote countercyclical financial inflows (in particular portfolio and bank loans) to semi-periphery countries. Second, semi-periphery countries with strong financial connections with center economies are more likely to experience larger countercyclical financial inflows. An explanation for these results is that international investors invest more in these semi-periphery economies that are perceived as financial substitution areas for their funds when the returns in center countries are not as attractive. By contrast, trade relations tend to compensate this pattern, and can lead to procyclical financial inflows for semi-periphery countries with very high level of trade openness and integration with the center economies. Third, foreign direct investments (FDIs) are not affected by the medium-term cycles as much as shorter-term financial flows. Fourth, the countercyclical pattern between medium-term cycles in large center economies and financial inflows is particularly salient for semi-periphery countries in contrast to smaller center and periphery economies. Indeed, while less robust, the financial flows to periphery countries tend to be procyclical.

5.2 Medium-term cycles and financial crises

Most, if not all, important references on financial crises link the financial liberalizations in center economies starting in the 1970s following the collapse of the Bretton Woods system and the associated ending of the generalized fixed floating exchange rate regimes in center economies with an historical re-emergence of financial crises (e.g., Eichengreen, 2004; Obstfeld and Taylor, 2005; Reinhart and Rogoff, 2009; Grossman, 2016). Yet, only a few of these contributions mention that these financial crises happened by waves, either in center (advanced) or in semi-periphery (emerging) economies (Calvo et al., 2004;

Aliber and Kindleberger, 2017). Why then such a pattern emerges and what does it tell us about the origins of the financial crises? What are the links between financial crises in center and in semi-periphery countries? Can paying attention to macroeconomic conjunctures in advanced economies help to understand these waves of crises? If so, what characterized these interactions? Do global investment strategies by international investors contribute to induce balance-of-payment distresses? If so, how does this happen? Chapter 3 complements the first study by suggesting answers to these questions, and especially by explaining a contributing factor to the origin of waves of crises in semi-periphery economies through the lens of recent past crisis episodes.

This study contributes to linking two established literatures: the studies on the origins of financial crises and those on medium-term cycles. The first group can be divided in three approaches; studies arguing that financial crises are the product of large range of mutually reinforcing domestic structural weaknesses such as limited financial development or under-regulated markets (e.g., Gourinchas and Obstfeld, 2012; Claessens et al., 2014; Mishkin, 1999; Berg, 1999; Diaz-Alejandro, 1985), those invoking a theory of "self-fulfilling" crises (see Radelet et al., 1998), and those discussing the role of global factors (e.g., Forbes and Warnock, 2012, 2020; Accominotti and Eichengreen, 2016). The second literature consists of more recent studies on the identification, the measurement, and the synchronization of medium-term cycles (e.g., Kose et al., 2003; Duval et al., 2014; Jordà et al., 2017). Importantly, Borio (2014) documents two crucial findings for center economies: (i) financial cycle peaks are markedly and closely associated with financial crises, and (ii) the financial liberalization and integration that started in the 1970s in advanced economies are viewed as the origin of these large financial fluctuations. By combining these observations, this study proposes an explanation of the origins of waves of financial crises in semi-periphery countries based on balance-of-payment tensions that periodically emerge from the medium-term conjunctural fluctuations of macroeconomic factors in center economies.

Based on the hierarchical center–periphery frameworks introduced in Braudel (1975) and Wallerstein (1974), countries were classified in two important groups based on the macroeconomic characteristics: the center leader (large and advanced) countries and semi-periphery (i.e., characterized by an intermediate stage of economic development) countries. Relying on the methodology detailed in Drehmann et al. (2012), this study defined the financial cycles as the medium-term component in the joint fluctuations of private credit, the credit-to-GDP ratio, and real-estate prices. Likewise, the industrial cycles are described as the medium-term component in the joint fluctuations of capacity utilization, unemployment rate, and GCF in center countries. Macroeconomic indicators are built based on these definitions. The study then developed a theoretical model of how these CLIF cycles trigger large countercyclical financial inflows in semi-periphery countries that subsequently create balance-of-payment financial crisiss (BOP crisiss). To evaluate the explanation, an historical review of the crises in semi-periphery countries since the 1970s is developed, based on estimates of the medium-term cycles in center economies, key macroeconomic indicators, including aggregate changes in the balance of payments of semi-periphery countries.

Based on the empirical findings that medium-term cycles in center countries have been countercyclical to capital inflows towards semi-periphery countries since the 1970s, the study suggests that investors of center countries change their investment allocations following the medium-term cycles in their domestic economies. Driven by the search for higher yield, they are incentivized to invest a larger fraction of their capital in semi-periphery countries when investment opportunities in center countries provide lower returns or the general macroeconomic condition is not a favorable (i.e., the downward phases of CLIF cycles), and in particular in semi-periphery countries experiencing major domestic pull factors or positively affected by major international pull factors. This in turn induces large financial inflows to the semi-periphery and hence triggers the creation of major wealth effects and focal points. The process ends due to (i) the ending of the downward phase of the CLIF cycles and the developments of new profitable investment opportunities in the center and/or (ii) the emergence of major international and/or domestic push factors that provoke large and disruptive financial outflows. In both cases, the dynamic cyclically threatens the financial and monetary stability of several semi-periphery economies.

The historical review of three waves of BOP crises in the semi-periphery between 1970 and 2020 confirms the theoretical views. A first period is characterized by low interconnections of financial markets between the center and the semi-periphery, large bank loans to the semi-periphery, disruptive oil shocks, and the dramatic increase in the interest rates in the US around the turn of the 1980s. A second period is marked by a greater economic integration of several semi-periphery countries into the global economy with the development of IPNs, a surge in FDIs and portfolio investments into the semi-periphery, and the collapse of the USSR. The end of the second period brought about BOP crises between 1994 and 2002. A third period is characterized by the real-estate and financial bubble of the early 2000s, the resulting GFC, the slowdown of Chinese economy and the "taper tantrum" during the 2010s, as well as accommodating monetary policies.[1] Importantly, the analysis highlights that for every period the downward phase of CLIF cycles triggered considerable financial inflows to the semi-periphery and that the waves of crises in semi-periphery economies (in 1980-1990, 1994-2002, and 2007-2018) are each linked with an upward and downward phase of the CLIF cycles.

5.3 International monetary policy spillovers

Chapter 4 addresses a few crucial questions regarding the evolution of international monetary policy spillovers over the last decades. How did monetary spillovers evolve over nearly half a century? Are changes driven by changes in economic relationships between countries? Are they driven by changes in how central bankers react to the policies of their peers? If both are true, which one is dominant? Are international spillovers US-centered? Are we in a multipolar system, in which each country contributes

[1] Taper tantrum describes the 2013 panic in several financial markets that triggered a spike in US Treasury yields, after international investors learned that the Fed was going to slowly put a brake on its quantitative easing program.

to the international transmission of monetary policy? Does this vary over time? These questions are of particular importance given the attention from academic economists and practitioners amid ongoing debates about the impact of economic globalization on monetary independence and international monetary spillovers (Breitenlechner et al., 2021; Antonakakis et al., 2019; Montecino, 2018).

More specifically, this study is at the cross-road of three empirical questions. Firstly, recent evidence from academic literature on international monetary spillovers shows that they are sizable (Breitenlechner et al., 2021; Montecino, 2018). Relying on various approaches (base-country, bilateral VAR, global VAR or spatial econometrics), researchers suggested a rising level of interdependencies rooted in financial and trade globalization. Yet, there is a poor understanding of the effective evolution of these monetary spillovers over time. This is partially because this task is "computationally challenging" (Crespo Cuaresma et al., 2019). As noted in the same study, there is limited evidence to support that the strength of spillovers has weakened in the aftermath of the global financial crisis, while Antonakakis et al. (2019) argue the opposite. These diverging views illustrate the need for further assessments. Secondly, Crespo Cuaresma et al. (2019) stressed that they leave the question of the forces driving the spillovers (i.e. economic integration or monetary policy sensitiveness) open. Going beyond the estimation of time varying monetary spillovers by separating the effects of economic globalization and monetary response sensitivity is not trivial and requires to overcome critical hurdles. A key purpose of the chapter is to complement the literature by proposing an empirical test to address this issue. Thirdly, the empirical literature often seems to confirm the importance of the Fed in regard to monetary spillovers. For example, (Ca' Zorzi et al., 2021, 2020) suggest that the US plays a central role. Additional recent empirical assessments showed that the Fed has been impacted by the ECB, and subject to major spillbacks from its own policies (Breitenlechner et al., 2021; Antonakakis et al., 2019). Despite the importance of the question, no empirical assessment of the importance of the US relative to other central banks exists in the literature on international monetary spillovers. To my knowledge, this study is the first attempt to (i) evaluate the evolution of spillovers over the last four decades, (ii) propose a method to disentangle the role of economic integration from the sensibility to peers' monetary policy, and (iii) assess the evolution of the Fed influence in a multipolar framework.

Inspired by the generalized autoregressive score models applied in a spatial regression context (Blasques et al., 2016b; Catania and Billé, 2017) and the forecasting models in finance (Stock and Watson, 2003, 2007), a new statistical model is developed to estimate the time-varying spatial dependence coefficient in panel datasets: the local kernel spatial regression (LKSR) procedure. This method consists in a time-varying spatial regression model based on maximum likelihood (ML) and local kernel techniques. The LKSR is a multipolar approach. That is, it takes into account the network structure of interaction between economies. This is implemented by a time-varying transmission channel matrix W_t based on international trade linkages. The study adopted an unique-scaling factor normalization of this transmission channel matrix in order to conserve the structure of interaction captured by international trade data. Critically, this normalization enables to propose a original empirical identification strategy. In summary, it is shown that under reasonable assumptions it is possible to disentangle international monetary policy spillovers induced by the intensification of globalization (the scale factor, s_t) from peers effects; that is, the sensitivity of monetary policy decisions in response to other central banks' policies at a given integration level (the sensitivity factor, θ_t). An additional methodological contribution is the definition of a formal empirical test for the multipolar hypothesis, which asserts that monetary spillovers are the result of global interdependencies and are better represented by a multipolar approach. This is achieved by a ML estimation using the LKSR procedure with two different transmission channel matrices, each reflecting either a multipolar or a US-centered unipolar transmission of monetary policy spillovers.

The study empirically documents the existence of sizable international monetary policy spillovers across monetary areas that have risen considerably since the 1980s. Moreover, the findings suggest that economic integration between economies has played an important role as driver of this upward tendency in monetary interdependence. Indeed, while economic integration increased markedly during this period, central banks tended to react less, for a given level of integration, to foreign monetary policies. The estimate of central bank sensitivity substantially decreases between 1990 and the 2008 GFC, and reaches a stable level afterwards. The magnitude of these spillovers suggests that they represent significant threats to the achievement of the domestic objectives of monetary policy authorities. Especially, countries seem to have partially lost their autonomy on the conduct of monetary policy through economic integration. Several assessments confirm that monetary spillovers result from global interdependencies and are better represented by a multipolar approach. Exploring the role of the Fed, the results support the existence of a multipolar, rather than US-centered unipolar, system over the entire period, on average. The findings indicate that the US interest rate was a major source of monetary spillovers and its relative influence peaked in the 2000s. However, its relative influence has declined since the 2008 GFC and central bank monetary policy decisions tend to be have become even more multipolar than unipolar (or US-centered).

5.4 Future perspectives

The studies presented in this thesis – Chapters 3, 2 and 4 – provide a better understanding of some impacts of economic globalization on the monetary policy decisions, financial and monetary autonomy. Yet important questions raised in Chapter 1 have remained unanswered. Moreover, my results have opened up new questions requiring additional inquiries and investigations. New research is needed to pursue further my findings, a few of which are discussed to conclude.

Additional theoretical developments, historical analyses, and econometric tests could be the object of future studies extending the findings of Chapter 3. Different types of financial crises (e.g., currency, inflation, banking crises) occurred in the semi-periphery.

Based on existing classifications (e.g., Reinhart and Rogoff, 2009) or additional compilations, it would be interesting to formally assess whether some types crises are more driven than others by the influence of CLIF cycles. In the same vein, the roles of different pull and push factors as well as economic policies on the impacts of the industrial and financial cycles of the center on the semi-periphery need to be empirically assessed. For example, several empirical studies documented that macroeconomic and financial vulnerabilities to external conditions are greater under less flexible exchange rate regimes (Ghosh et al., 2015; Obstfeld et al., 2018, e.g.,). Yet, Alexis (2021) contradicts this claim and supports the implementation of fixed foreign exchange rate regimes by emerging and developing countries. It would be interesting to conduct additional assessments of the efficiency of various exchange rate regimes for different phases of the CLIF cycles. Further region-specific research (in particular focusing on the Latin American, European, or East Asian semi-periphery), on specific periods, and on the impact of the rising role of China are also needed. The impact of the 2020-21 COVID-19 crisis has not been assessed. Once more data is available and with the clarity of hindsight, the model outlined in this study can provide useful insight to assess the period (which could confirm or infirm the explanation). In addition, the study has an important potential for policy recommendations. Indeed, the empirical evidence that CLIF cycles impact financial conditions in semi-periphery countries and generate disruptive financial flows should lead semi-periphery countries to search of counterbalancing measures to smooth and bolster their growth, financial development, and industrialization. Such countercyclical tightening capital flow management and/or macro-prudential policies aiming at curbing speculative financial inflows, limit the appreciation of their currencies, and prevent excessive credit growth could limit the macroeconomic fluctuations provoked by large downward phases in the CLIF cycles. Several semi-periphery countries already implemented monetary policies in this direction. For example, central banks in Brazil, Colombia, Peru, South Korea, Thailand, and Indonesia introduced or reinforced such policies in the aftermath of – and, in few occasions, before – the 2008 GFC enabling them to alleviate the impact of the crisis (Conti-Brown and

Lastra, 2018; Tooze, 2018). In that regard, complementing the recent evaluations on the strategy to avoid the pain from balance-of-payment pressures (Ghosh et al., 2016; Cavallo et al., 2020), empirical assessments of the efficiency of these monetary policies are need to better understand the advantages and limits of diverse specific monetary tools.

Chapter 2 provides statistical evidence that CLIF cycles impact the pattern of international financial flows between the center and the semi-periphery. Yet, the study left a few questions open. Interestingly, it is often argued that global shocks (e.g., global risk aversion shocks such as measured by the Cboe Volatility Index) have had important negative effects on net financial flows to semi-periphery countries because international investors repatriate their funds from the semi-periphery in reaction to these shocks (Shim and Shin, 2021). Likewise, this phenomenon was highlighted again in the early stages of the COVID-19 crisis, when portfolio flows to semi-periphery countries swiftly and massively reversed. However, my findings support that on average more funds are invested in the semi-periphery during the downward phases of the CLIF cycles Two elements are worth mentioning in regard to this apparent paradox. First, an explanation might be that local investors play a stabilizing role, offsetting the retrenchment of foreign investors (Adler et al., 2016). Second, the difference could stem from two different temporal interpretations. While indicators of global factors – including my estimates of the CLIF cycles – are usually strongly correlated with indicators of global risk aversion, the defining in empirical studies of "shocks" tend to overweight short-term fluctuations. My approach focuses on medium-term components. It is therefore possible that two effects affect the net financial flows in opposite directions over different time-spans. Further research is therefore needed to validate this hypothesis. For example, exploiting the framework, this could be implemented by decomposing the global influence into two ranges of frequency. Importantly, Chapter 2 does not incorporate the influence of China. Given the considerable growth of the country and its impact on the global economy, it would be of great value to assess whether China exacerbates or mitigates the impact of the CLIF cycles on net financial flows to semi-periphery countries. By the same token, it would be extremely relevant to extend the analysis by focusing on the heterogeneities within semi-periphery countries. This would likely provide additional insights on the links between the medium-term cycles and net financial flows.

Two categories of studies could extend Chapter 4; by complementing the research on its econometric dimension, or by exploiting the approach from distinct economic angles. On the econometric side, the LKSR estimation procedure seems attractive for a few reasons. It is computational vast and converge more easily that its "main competitor" based on generalized autoregressive score models. The estimation being local, the procedure is also more capable to incorporate structural breaks in the data, outliers only after local values (and not the overall estimation) and the Monte-Carlo tests indicate that it usual better fit abrupt changes in the coefficients. Yet, the method is also importantly limited on three fronts. A program was built in the R programming language enabling the procedure to be implemented for further research. Yet, many researchers exploit other statistical softwares and programming languages that, due to its novelty, do not incorporate the procedure. While the estimations seem promising, no inferential statistics have been developed and the program does not provide confidence intervals nor p-values. Moreover, the procedure itself can be potentially improved by adding a few components: an automatic "time-varying" bandwidth to adjust for periods with abrupt transformations and those more stable within a sample, an procedure to better fit the evolving distribution of the error terms, or specific designs to avoid local sensitivity to outliers. These elements could flesh out the current LKSR estimation procedure. Finally, the development of a formal likelihood-ratio test to statistically assess the difference between the uses of two spatial weighting matrix in the model would be a good addition to confirm or inform the multipolar hypothesis as well as to enrich the econometric model. On the economic side, the study opened new perspective of research. Indeed, while the estimations indicate that international monetary policy spillovers rose these last four decades, Chapter 2 does not cover other types of international spillovers. For example, it would be valuable to provide similar estimates for short-term and long-term market interest rates as well as banking lending rates. This could infirm or confirm some of the conjonctures made in the discussion of the chapter. Likewise, the method can also be applied to other macroeconomic dynamics as well as intraregional spillovers. As an illustration, estimations of intra-European or intra-American monetary spillovers could inform us on the influence of regional integration. Additionally, assessing inflation spillovers and their key determinants exploiting the flexible framework proposed could also illustrate a component of the influence of economic integration on monetary policy and domestic macroeconomic conditions. Notably, these potential axes of research would be inevitably limited by data availability – as crucial limit of this research –, for the interest rates or other dependent variables as well as for the building of a transmission channel matrix (TCM). It is therefore likely that a shorter-term perspective would be needed to conduct such analyses.

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Appendix A | Complements to Chapter 2

A.1 Details on the model

This section provides the demonstrations and additional discussions for the two-country and N-country models of Subsections 2.2.1 and 2.3.1. Subsection A.1.4 discusses the transition from the solution of the N-country model to the spatial regression developed in Section 2.2.2.

A.1.1 Solution for the problem with two countries (Subsection 2.2.1)

The optimization problem introduced in Subsection 2.2.1 can be formulated as follows:

$$\boldsymbol{\theta}_{it}^{*} = \underset{\boldsymbol{\theta}_{it}}{\operatorname{argmax}}\, E\left[R_{i,t+1}(\boldsymbol{\theta}_{it})\,|I_{it}\right] - \lambda_{it} E\left[Risk_{i,t+1}(\boldsymbol{\theta}_{it})\,|I_{it}\right] \tag{A.1}$$

with the model of risk being $E\left[Risk_{i,t+1}(\boldsymbol{\theta}_{it})\,|I_{it}\right] = \frac{1}{2}\left(\sigma_{sit}\theta_{sit}^2 + \sigma_{cit}\theta_{cit}^2\right)$ and the anticipated return estimated by

$$E\left[R_{i,t+1}(\boldsymbol{\theta}_{it})\,|I_{it}\right] = \theta_{cit}\left\{\kappa_{cit} + f(A_t)\right\} + \theta_{sit}\left\{\kappa_{sit} + \eta Q_{st} + \epsilon f(A_t)\right\}. \tag{A.2}$$

In addition, we must add the constraint that $\theta_{cit} + \theta_{sit} = 1$. By substituting θ_{cit} by $1 - \theta_{sit}$, the problem becomes:

$$\theta_{sit}^{*} = \underset{\theta_{sit}}{\operatorname{argmax}}\,(1-\theta_{sit})\left[\kappa_{cit} + f(A_t)\right] + \theta_{sit}\left[\kappa_{sit} + \eta\theta_{sit} + \epsilon f(A_t)\right] - \frac{\lambda_{it}}{2}\left[\sigma_{sit}\theta_{sit}^2 + \sigma_{cit}\left(1-\theta_{sit}\right)^2\right] \tag{A.3}$$

Case for $0 < \theta_{sit} < 1$ and $\lambda_i > 2\eta_i$. In this context, the solution to the optimization problem is given by the constraint that the derivative of the objective function must be equal to zero. This can be formulated as follows:

$$\frac{\partial \mathcal{O}}{\partial \theta_{sit}} = -\left[\kappa_{cit} + f(A_t)\right] + \left[\kappa_{sit} + 2\eta\theta^*_{sit} + \epsilon f(A_t)\right] - \lambda_{it}\left[\sigma_{sit}\theta^*_{sit} + \sigma_{cit}\left(-1 + \theta^*_{sit}\right)\right] = 0. \tag{A.4}$$

By isolating θ^*_{sit}, we obtain:

$$\theta^*_{sit}\left[\lambda_{it}\left(\sigma_{sit} + \sigma_{cit}\right) - 2\eta_i\right] = -\kappa_{cit} - f(A_t) + \kappa_{sit} + \epsilon f(A_t) + \lambda_{it}\sigma_{cit} \tag{A.5}$$

$$\Leftrightarrow \qquad \theta^*_{sit} = \frac{\left[\lambda_{it}\sigma_{cit} + \kappa_{sit} - \kappa_{cit} - (1-\epsilon)f(A_t)\right]}{\left[\lambda_{it}\left(\sigma_{sit} + \sigma_{cit}\right) - 2\eta_i\right]} \tag{A.6}$$

Using the constraint that $\sigma_{sit} + \sigma_{cit} = 1$, the following result (equivalent to the solution discussed in Subsection 2.2.1) is then obtained:

$$\theta^*_{sit} = \frac{\lambda_{it} - \sigma_{sit}\lambda_{it} + \kappa_{sit} - \kappa_{cit}}{\lambda_{it} - 2\eta_i} - \frac{(1-\epsilon)f(A_t)}{\lambda_{it} - 2\eta_i} \tag{A.7}$$

Case for $0 \leq \theta_{sit} \leq 1$ and $\lambda_i > 2\eta_i$. While Equation A.7 can seem to indicate us that the changes in share of the investment into the semi=periphery due to the CLIF cycles, $\frac{\partial \theta^*_{sit}}{\partial A_t}$, is independent of the constant part of the expected returns (κ_{sit} and κ_{cit}) and, maybe more surprisingly, the risk valuation of the area, σ_{sit}, this is not the case if the investor i, along the changes in the CLIF cycles, stop investing in one of the two areas. That is $\theta^*_{sit} = 0$ or $\theta^*_{sit} = 1$ at a specific t. For instance, this can happen if the returns in the center climb up because A_t is rising such that the right-hand part of Equation A.7 becomes negative and therefore $\theta^*_{sit} = 0$. Indeed, a more general solution to the optimization problem is given by:

$$\theta^*_{sit} = \begin{cases} 1 & \text{if} \quad -\sigma_{sit}\lambda_{it} + \kappa_{sit} - \kappa_{cit} - (1-\epsilon)f(A_t) + 2\eta_i > 0 \\ 0 & \text{if} \quad \lambda_{it} - \sigma_{sit}\lambda_{it} + \kappa_{sit} - \kappa_{cit} - (1-\epsilon)f(A_t) < 0 \\ \dfrac{\lambda_{it} - \sigma_{sit}\lambda_{it} + \kappa_{sit} - \kappa_{cit}}{\lambda_{it} - 2\eta_i} - \dfrac{(1-\epsilon)f(A_t)}{\lambda_{it} - 2\eta_i} & \text{otherwise} \end{cases} \tag{A.8}$$

This solution can also be written as follows:

$$\theta^*_{sit} = \tilde{\theta}_{sit}\left(1 - \mathbb{1}_{[\tilde{\theta}_{sit}<0]}\right) + \mathbb{1}_{[\tilde{\theta}_{sit}>1]}\left(1 - \tilde{\theta}_{sit}\right) \tag{A.9}$$

with $\tilde{\theta}_{sit} = \frac{\lambda_{it} - \sigma_{sit}\lambda_{it} + \kappa_{sit} - \kappa_{cit}}{\lambda_{it} - 2\eta_i} - \frac{(1-\epsilon)f(A_t)}{\lambda_{it} - 2\eta_i}$ and $\mathbb{1}$ the indicator (or characteristic) function of the condition on its index. We then see that the impact of the CLIF cycles on the allocation of fund is influenced by these factors (κ_{sit}, κ_{cit}, and σ_{sit}) because they contribute to determine the thresholds in the first and second lines of Equation A.8 or, similarly, in the indicator functions in Equation A.9. Considering a large number of investors, and the total amount of fund invested to the semi-periphery in t, we have

$$\phi_{st} = \sum_{i=1}^{M} q_{it}\theta^*_{sit} = \sum_{i=1}^{M} q_{it}\tilde{\theta}_{sit} - \sum_{i=1}^{M} q_{it}\tilde{\theta}_{sit}\mathbb{1}_{[\tilde{\theta}_{sit}<0]} + \sum_{i=1}^{M} q_{it}(1-\tilde{\theta}_{sit})\mathbb{1}_{[\tilde{\theta}_{sit}>1]}.$$

Case for $\lambda_i < 2\eta_i$. In this case, $\mathcal{O}$ is convex.[1] Indeed, the second derivative of the objective function is then $\frac{\partial^2}{\partial^2}\mathcal{O} = 2\eta_{it} - \lambda_{it}$, which is positive when $\lambda_i < 2\eta_i$. Therefore, the previous solution is a minimum. In such cases, the maximum for θ_{st} is either 0 or 1. The investor i would then invest all their fund in either the center or the semi-periphery, but never in both areas. More specifically, the total of q_{it} is invested in the center (that is $\theta^*_{sit} = 0$) if $(1-\epsilon)f(A_t) > [\lambda_{it}(\sigma_{cit} - \sigma_{sit})/2 + \kappa_{sit} - \kappa_{cit} + \eta_i]$. If ϵ becomes high (close to 1), the investor invests where they considers that the risk is the lowest; that is in the semi-periphery if $\sigma_{sit} < \sigma_{cit}$ (not considering κ_{sit}, κ_{cit} nor η_i as driving forces).

[1]When $\lambda_i = 2\eta_i$, the objective function is flat and the investor i has no preference between the center and the semi-periphery. I ignore this case in the rest of the analysis.

A.1.2 Details on the decomposition of q_{it} for the two-country model

The amount invested by the investor i in period t, q_{it}, is the difference between their gain in capital (the amount invested in $t-1$ multiplied by the returns) and their consumption, such that the q_{it} is given by:

$$q_{it} = R_{it} q_{i,t-1} - C_{it} \tag{A.10}$$

with C_{it} the consumption of investor i during that period. Because of a potentially significant wealth-related effect, the consumption itself might depend on the CLIF cycles. I consider here two examples of how to model these changes in consumption: C_{it} as a function of the return R_{it} or of the wealth q_{it}.

1. Firstly, I assume that the consumption C_{it} is regarded as a function of the return, meaning that the higher the returns are the higher the consumption is. Then, $C_{it} = C(R_{it})$ with C a monotonically increasing function, $\frac{\partial C}{\partial R_{it}} = C' > 0$. Investors tend to consume more than they obtained more from their investments in the previous period. Equation A.10 can be rewritten as $q_{it} = R_{it} q_{i,t-1} + C(R_{it})$. Therefore, for a given level of investment in $t-1$, the variation of the investment in t due to the CLIF cycles is given by $\frac{\partial q_{it}}{\partial A_t}_{|q_{i,t-1}} = (q_{i,t-1} + C') \frac{\partial R_{it}}{\partial A_t}$.

2. Secondly, I assume that the consumption C_{it} is now modeled as a function of the wealth. The available wealth in t equals the product of the previous investment and the returns, $R_{it} q_{i,t-1}$. Considering the previous decision of investment, $q_{i,t-1}$ as exogenous, we have the same relation than above, that is $C_{it} = C(R_{it})$ with C a monotonically increasing function, and the same result holds. Another option consists in viewed the wealth as the investable wealth, such that $C_{it} = C(q_{it})$, with again C a monotonically increasing function. In such case, the derivative of R_{it} with q_{it} can be formulated as $\frac{\partial R_{it}}{\partial q_{it}}_{|q_{i,t-1}} = \frac{1}{q_{i,t-1}} (1 + C') > 0$.

Importantly, in both cases, q_{it} monotonically increases when R_{it} increases for a given level of $q_{i,t-1}$. Consequently we can write $\frac{q_{it}}{q_{i,t-1}} = d_{it}(R_{it})$ with $\frac{\partial d_{it}}{\partial R_{it}} = d'_{it} > 0$. Therefore, the variation of the investment is expressed as $\frac{\partial}{\partial A_t}\frac{q_{it}}{q_{i,t-1}} = \frac{\partial}{\partial A_t} d_{it}(R_{it}) = d'_{it}\frac{\partial R_{it}}{\partial A_t}$ and the evolution of q_{it} throughout the CLIF cycles is driven by the changes in returns throughout these cycles.

The returns in period t due to the investment decision in the previous period, that is θ^*_{sit}, is given by:[2]

$$R_{it} = \theta^*_{sit} r_{sit} + \theta^*_{cit} r_{cit} = \left(\delta_{0,it} + \delta_{1,it} f(A_t)\right)(r_{sit} - r_{cit}) + r_{cit} \tag{A.11}$$

with $\delta_{0,it} = \frac{\lambda_i - \lambda_i \sigma_{sit} + (\kappa_{sit} - \kappa_{cit})}{\lambda_i - 2\eta_i}$ and $\delta_{1,it} = -\frac{(1-\epsilon)}{\lambda_i - 2\eta_i}$. Because $\delta_{1,it} < 0$, we have that the share of financial investments to the semi-periphery evolve countercyclically with the CLIF cycles.[3] Without necessarily supposing that the expectation of the investor i are correct, but assuming a similar structure of the returns r_{sit} and r_{cit} such that they are given by $r_{sit} = \tilde{\kappa}_{sit} + \tilde{\eta} q_{t-1} + \tilde{\epsilon}\tilde{f}(A_t)$ and $r_{cit} = \tilde{\kappa}_{cit} + \tilde{f}(A_t)$ with $\frac{\partial \tilde{f}}{\partial A_t} > 0$ and $\tilde{\epsilon} < 1$. In such case, the changes in the total return is caused by A_t can be formulated as follows:[4]

$$\frac{\partial R_{it}}{\partial A_t} = \frac{\partial \theta^*_{sit}}{\partial A_t}(r_{sit} - r_{cit}) + \theta^*_{sit}\frac{\partial}{\partial A_t}(r_{sit} - r_{cit}) + \frac{\partial r_{cit}}{\partial A_t} \tag{A.12}$$

$$= \underbrace{\delta_{1,it}}_{<0}\underbrace{\frac{\partial f}{\partial A_t}}_{>0}\underbrace{(r_{sit} - r_{cit})}_{<0} + \underbrace{\theta^*_{sit}}_{>0}\underbrace{(\tilde{\epsilon} - 1)}_{<0}\underbrace{\frac{\partial \tilde{f}}{\partial A_t}}_{>0} + \underbrace{\frac{\partial \tilde{f}}{\partial A_t}}_{>0} \tag{A.13}$$

$$\geq \underbrace{\delta_{1,it}\frac{\partial f}{\partial A_t}(r_{sit} - r_{cit})}_{>0} + \underbrace{\tilde{\epsilon}\frac{\partial \tilde{f}}{\partial A_t}}_{>0} > 0. \tag{A.14}$$

where we assume that the center economies are overall more attractive than semi-periphery economies, that is $r_{cit} > r_{sit}$. The origin of the inequality at the last line comes from the fact that only the second term of the left-hand side of the equation is negative in the second line $(\theta^*_{sit}(\tilde{\epsilon} - 1)\frac{\partial \tilde{f}}{\partial A_t})$. Because $\theta^*_{sit} \in [0,1]$, we have that $\theta^*_{sit}(\tilde{\epsilon} - 1)\frac{\partial \tilde{f}}{\partial A_t} > (\tilde{\epsilon} - 1)\frac{\partial \tilde{f}}{\partial A_t}$.

[2] For ease, I assume here that $0 < \theta_{sit} < 1$ and $\lambda_i > 2\eta_i$. Remind that $\theta^*_{sit} = 1 - \theta^*_{cit}$.

[3] As in Subsection 2.2.1, I assume that ϵ is not higher than 1 for the all semi-periphery.

[4] For simplicity, I assume that $\tilde{\eta} = 0$. Note that the inequality $\frac{\partial R_{it}}{\partial A_t} > 0$ still holds if $\tilde{\epsilon} \geq 1$.

Based on these elements, two key findings can be highlighted; (i) the evolution of q_{it} throughout the CLIF cycles is driven by the changes in returns throughout these cycles $\frac{\partial}{\partial A_t}\frac{q_{it}}{q_{i,t-1}} = d'_{it}\frac{\partial R_{it}}{\partial A_t}$ with $d'_{it} > 0$, and (ii) the total return R_{it} evolves procyclically with the CLIF cycles, $\frac{\partial R_{it}}{\partial A_t} > 0$. Therefore, the amount invested q_{it} also evolves procyclically, $\frac{\partial}{\partial A_t}\frac{q_{it}}{q_{i,t-1}} > 0$. This is the reason why I assume in the core of this study (Subsection 2.2.1) that q_{it} can be decompose into two components, with only one depending on A_t such that $q_{it} = \tilde{q}_{it} + g_{it}(A_t)$ and $g'_{it} = \frac{d}{dA_t}g_{it} > 0$.

A.1.3 Solution for the problem with N countries (Subsection 2.3.1)

The optimization problem for N-country model (N_c center countries and N_{sp} semi-periphery countries) such as developed in Subsection 2.3.1 can be formulated as follows (Equation 2.8):

$$\begin{aligned}\boldsymbol{\theta}^*_{it} = \underset{\boldsymbol{\theta}_{it}}{\operatorname{argmax}} & \sum_{n\in S_c} \theta_{nit}u_{nit}\left[\kappa_{nit} + f(A_{nt})\right] \\ & + \sum_{n=S_{sp}} \theta_{nit}u_{nit}\left[\kappa_{nit} + \sum_{l\in S_c}\epsilon_{nl}f(A_{lt})\right] - \frac{\lambda_i}{2}\sum_{n\in S_T}\frac{\sigma_{nit}(\theta_{nit})^2}{\upsilon_{nit}},\end{aligned} \tag{A.15}$$

with $r_{nit} = \kappa_{nit} + f(A_{nt})$ for center economies ($n \in S_c$) and $r_{nit} = \kappa_{nit} + \sum_{l\in S_c}\epsilon_{nl}f(A_{lt})$ for semi-periphery economies ($n \in S_{sp}$) and with the constraint that the total of shares invested in the different countries equals one, that is $\sum_{n=1}^{N}\theta_{nit} = 1$.

For ease in notation, without changing the formal problem, we can omit the time index (t) as well as the index for the investor (i). This optimization problem can be formally reformulated as a particular case of the following problem:

$$\boldsymbol{\theta}_{max} = \underset{\boldsymbol{\theta}}{\operatorname{argmax}}\left(\sum_{n=1}^{N}\theta_n h_n\right) - \frac{\lambda}{2}\sum_{n=1}^{N}\frac{(\theta_n)^2}{\nu_n}, \qquad \text{such that} \qquad \sum_{n=1}^{N}\theta_n = 1 \tag{A.16}$$

with $h_n = u_{nit}r_{nit}$ and $\nu_n = \frac{\upsilon_{nit}}{\sigma_{nit}}$ to reproduce Equation A.15.

Case for $0 < \theta_{sit} < 1$. In this context, the Lagrangian function of the optimization problem is given by:

$$\mathcal{L}(\boldsymbol{\theta}, \lambda) = \sum_{n=1}^{N} \theta_n h_n - \frac{\lambda}{2} \sum_{n=1}^{N} \frac{(\theta_n)^2}{\nu_n} + \zeta \left[\sum_{j=1}^{N} \theta_n - 1 \right]. \tag{A.17}$$

where ζ is the Lagrangian multiplier for the constraint $\sum_{n=1}^{N} \theta_{nit} = 1$.

The derivative of the Lagrangian function with θ_n is:

$$\frac{\partial \mathcal{L}(\boldsymbol{\theta}, \lambda)}{\partial \theta_n} = h_n - \frac{\lambda}{\nu_n} \theta_n + \zeta = 0. \tag{A.18}$$

This equation holds for all $n \in \{1, \ldots, N\}$, so that we can write the following steps:

$$\zeta = \frac{\lambda}{\nu_n} \theta_n - h_n, \qquad \forall n \in \{1, \ldots, N\} \tag{A.19}$$

$$\Leftrightarrow \qquad \frac{\lambda}{\nu_k} \theta_k - h_k = \frac{\lambda}{\nu_n} \theta_n - h_n, \qquad \forall n, k \in \{1, \ldots, N\} \tag{A.20}$$

$$\Leftrightarrow \qquad \theta_k = \frac{\nu_k}{\lambda} \left[\frac{\lambda}{\nu_n} \theta_n - h_n + h_k \right], \qquad \forall n, k \in \{1, \ldots, N\} \tag{A.21}$$

$$\Leftrightarrow \qquad \sum_{k=1}^{N} \theta_k = \sum_{k=1}^{N} \frac{\nu_k}{\lambda} \left[\frac{\lambda}{\nu_n} \theta_n - h_n + h_k \right], \qquad \forall n \in \{1, \ldots, N\} \tag{A.22}$$

$$\Leftrightarrow \qquad 1 = \frac{\lambda}{\nu_n} \theta_n \left(\frac{1}{\lambda} \sum_{k=1}^{N} \nu_k \right) - h_n \left(\frac{1}{\lambda} \sum_{k=1}^{N} \nu_k \right) + \left(\frac{1}{\lambda} \sum_{k=1}^{N} \nu_k h_k \right), \qquad \forall n \in \{1, \ldots, N\} \tag{A.23}$$

By isolating θ_n in this last equation, we obtain the searched result:

$$\theta_n^* = \frac{\nu_n}{\lambda \left[\sum_{k=1}^{N} \nu_k \right]} \left[h_n \sum_{k=1}^{N} \nu_k - \sum_{k=1}^{N} \nu_k h_k + \lambda \right] \tag{A.24}$$

If we come back to the notation from the core of this study, we can reformulate the optimal allocation in the semi-periphery country n for the investor i in time t as follows (equivalent to Equation 2.9):

$$\theta^*_{nit} = \frac{v_{nit}}{\lambda_i \sigma_{nit} \delta_{it}} \left\{ u_{nit} \left[\kappa_{nit} + \sum_{l \in S_c} \epsilon_{nl} f(A_{lt}) \right] \delta_{it} - \sum_{k \in S_c} \frac{v_{kit} u_{kit}}{\sigma_{kit}} \left[\kappa_{kit} + f(A_{kt}) \right] \right.$$
$$\left. - \sum_{k \in S_{sp}} \frac{v_{kit} u_{kit}}{\sigma_{kit}} \left[\kappa_{kit} + \sum_{l \in S_c} \epsilon_{kl} f(A_{lt}) \right] + \lambda_i \right\} \quad \text{(A.25)}$$

with $\delta_{it} = \sum_{k=1}^{N} \frac{v_{kit}}{\sigma_{kit}}$. In this equation, we separate the components for the center and for the semi-periphery. This relation can be rewritten by isolating the right-hand terms depending on the CLIF cycles:

$$\theta^*_{nit} = \frac{v_{nit}}{\lambda_i \sigma_{nit} \delta_{it}} \left\{ \lambda_i + u_{nit} \kappa_{nit} \delta_{it} - \sum_{k \in S_T} \frac{v_{kit} u_{kit}}{\sigma_{kit}} \kappa_{kit} + \sum_{l \in S_c} \left[u_{nit} \delta_{it} \epsilon_{nl} - \sum_{k \in S_{sp}} \frac{v_{kit} u_{kit}}{\sigma_{kit}} \epsilon_{kl} - \frac{v_{lit} u_{lit}}{\sigma_{lit}} \right] f(A_{lt}) \right\} \quad \text{(A.26)}$$

Finally, this equation can be simplified by defining two key terms: (i) the proximity-weighted mean of the independent-of-the-CLIF cycles terms of the returns $\overline{\kappa}_{it} = \sum_{k \in S_T} \dfrac{v_{kit} u_{kit}}{\sigma_{kit}} \kappa_{kit}$, and (ii) the impact factor of the medium-term cycles in the center country m on the investment share in the semi-periphery country n, $\omega_{nimt} = u_{nit} \delta_{it} \epsilon_{nm} - \overline{\epsilon}_{imt} - \frac{v_{mit} u_{mit}}{\sigma_{mit}}$. In this relation, $\overline{\epsilon}_{imt}$ is the proximity-weighted mean of the direct impact of the medium-term cycles in the center country m on the semi-periphery and is expressed as follows $\overline{\epsilon}_{imt} = \sum_{k \in S_{sp}} \frac{v_{kit} u_{kit}}{\sigma_{kit}} \epsilon_{km}$. By exploiting these terms, the solution to the optimization problem is given by the following equation:

$$\theta^*_{nit} = \frac{v_{nit}}{\lambda_i \sigma_{nit} \delta_{it}} \left\{ \lambda_i + u_{nit} \kappa_{nit} \delta_{it} - \overline{\kappa}_{it} + \sum_{m \in S_c} \omega_{nimt} f(A_{mt}) \right\} \quad \text{(A.27)}$$

If we apply the normalization of $v_{\cdot it}$ such that $\sum_{k=1}^{N} \frac{v_{kit}}{\sigma_{kit}} = 1$, we obtain Equation 2.9.

Case for $0 \leq \theta_{sit} \leq 1$. In a scenario where the constraints $0 \leq \theta_{sit} \leq 1$ are included, meaning that they are regarded as potential binding constraints - in contrast to the previous scenario where it was assumed that these constraints were not binding -, the optimization solution given by the Lagrangian method (which allows only equality constraints), Equation A.24, is not generally correct. As a common alternative strategy allowing inequality constraints, the Karush–Kuhn–Tucker (KKT) conditions can be used as first-order necessary conditions, or first derivative tests, for the solution to be optimal (provided that the correct regularity conditions are satisfied).

The optimization problem can be written as follows (see Equation A.16):

$$\boldsymbol{\theta}_{max} = \operatorname*{argmax}_{\boldsymbol{\theta}} \mathcal{O}(\boldsymbol{\theta}) = \left(\sum_{n=1}^{N} \theta_n h_n\right) - \frac{\lambda}{2} \sum_{n=1}^{N} \frac{(\theta_n)^2}{\nu_n} \tag{A.28}$$

subject to

$$h(\boldsymbol{\theta}) = \sum_{n=1}^{N} \theta_n - 1 = 0 \tag{A.29}$$

$$g_n(\boldsymbol{\theta}) = -\theta_n < 0, \quad \forall \;\; n \in S_T \tag{A.30}$$

$$\tilde{g}_n(\boldsymbol{\theta}) = \theta_n - 1 < 0, \quad \forall \;\; n \in S_T \tag{A.31}$$

Fortunately, in this case, the KKT first-order necessary conditions are sufficient for optimality. This is because the objective function $\mathcal{O}$ is a concave function (and it is a maximization problem), the inequality constraint functions g_n and $\tilde{g}_n$ are continuously differentiable convex functions, and the equality constraint function h is an affine function.

These KKT first-order necessary conditions are given by the following equations:

$$\text{(stationary conditions)} \quad -\frac{\partial \mathcal{O}(\boldsymbol{\theta}^*)}{\partial \theta_n} + \zeta \frac{\partial h(\boldsymbol{\theta}^*)}{\partial \theta_n} + \sum^{n} \mu_n \frac{\partial g_n(\boldsymbol{\theta}^*)}{\partial \theta_n} + \sum^{n} \tilde{\mu}_n \frac{\partial \tilde{g}_n(\boldsymbol{\theta}^*)}{\partial \theta_n} = 0, \;\; \forall \;\; n \in S_T \tag{A.32}$$

$$\text{(primal feasibility condition 1)} \qquad h(\boldsymbol{\theta}) = \sum_{n=1}^{N} \theta_n - 1 = 0 \tag{A.33}$$

$$\text{(primal feasibility conditions 2)} \qquad g_n(\boldsymbol{\theta}) = -\theta_n < 0, \quad \forall \;\; n \in S_T \tag{A.34}$$

$$\text{(primal feasibility conditions 3)} \qquad \tilde{g}_n(\boldsymbol{\theta}) = \theta_n - 1 < 0, \quad \forall \;\; n \in S_T \tag{A.35}$$

$$\text{(dual feasibility conditions)} \qquad \mu_n \geq 0 \quad \text{and} \quad \tilde{\mu}_n \geq 0, \quad \forall \;\; n \in S_T \tag{A.36}$$

$$\text{(complementary slackness)} \quad \mu_n g_n(\boldsymbol{\theta}) = -\mu_n \theta_n = 0 \quad \text{and} \quad \tilde{\mu}_n \tilde{g}_n(\boldsymbol{\theta}) = \tilde{\mu}_n(1-\theta_n) = 0, \;\; \forall \;\, n \in S_T \tag{A.37}$$

The stationary conditions can be rewritten as follows:

$$-h_n + \lambda \frac{\theta_n}{\nu_n} + \zeta - \mu_n + \tilde{\mu}_n = 0, \quad \forall \;\; n \in S_T \tag{A.38}$$

For the sake of simplicity, I will assume that none of the θ_n^* equals one (in which case, all other investment shares equal zero), so that $\tilde{\mu}_n = 0$, $\forall \; n \in S_T$. In addition, without losing in generality, I also consider that, on the one side, if $n \in S_{\theta \neq 0}$ then θ_n^* is not zero and, on the other side, if $n \in S_{\theta = 0}$ then θ_n^* equals zero. By applying the same method that above (see Equation A.19 and the following ones), for $n \in S_{\theta \neq 0}$, the solution is given by:

$$\theta_n^* = \frac{\nu_n}{\lambda \delta} \left[h_n \delta - \sum_{k \in S_T} \nu_k h_k - \sum_{k \in S_{\theta=0}} \nu_k \mu_k + \lambda \right], \qquad \forall \; n \in S_{\theta \neq 0} \tag{A.39}$$

with $\delta = \sum_{k=1}^{N} \nu_k$. By the complementary conditions, $\mu_n = 0$ for all $n \in S_{\theta \neq 0}$. This solution is very close to Equation A.24 with a "corrective" term $\sum_{k \in S_{\theta=0}} \nu_k \mu_k > 0$ which decreases the value that θ_n^* would have otherwise taken in the absence of the constraint that $\theta_n \geq 0$. In other words, without this constraint, some θ_k's would take negative values enabling θ_n to increase more while still respecting the constraint that $\sum_n \theta_n = 1$. If the constraints $\theta_n \geq 0$, $\forall \; n$ are not binding, all μ_k equal zero and we return to the previous solution. Unfortunately, by contrast with Equation A.24, Equation A.39 is not a direct closed form solution because the term $\sum_{k \in S_{\theta=0}} \nu_k \mu_k$ depends on other factors.

By exploiting the stationary conditions for $k \in S_{\theta=0}$, and applying the same types of manipulations (using the primal feasibility condition $\sum_n \theta_n = 1$), we obtain the following relations:[5]

$$\mu_k = -h_k + \frac{1}{\delta_{S_{\theta\neq0}}}\left(\sum_{l\in S_{\theta\neq0}} \nu_l h_l - \lambda\right), \quad \forall\, k \in S_{\theta=0}, \quad \text{with} \quad \delta_{S_{\theta\neq0}} = \sum_{l\in S_{\theta\neq0}} \nu_l \quad \text{(A.42)}$$

Therefore, based on the complementary slackness, we have that $\theta_n^* = 0$ if $\mu_n > 0$ which is similar to $h_n < \frac{1}{\delta_{S_{\theta\neq0}}}\left(\sum_{l\in S_{\theta\neq0}} \nu_l h_l - \lambda\right)$. Using notations from the core of the paper, this condition becomes (for a semi-periphery country):

$$\theta_{nit}^* = 0 \quad \text{if} \quad u_{nit} r_{nit} = u_{nit}\left(\kappa_{nit} + \sum_{l\in S_c} \epsilon_{nl} f(A_{lt})\right) < \frac{1}{\delta_{S_{\theta\neq0}}}\left(\sum_{l\in S_{\theta\neq0}} \frac{v_{lit}u_{lit}}{\sigma_{lit}} r_{lit} - \lambda_i\right), \quad \text{(A.43)}$$

with $\delta_{S_{\theta\neq0}} = \sum_{l\in S_{\theta\neq0}} \frac{v_{lit}}{\sigma_{lit}}$. That means that an investor i does not invest in the country n if its proximity-weighted expected returns $u_{nit} r_{nit}$ are too small relative to the proximity-and-risk-weighted average of the expected returns in non-zero-investment countries (i.e., $\frac{1}{\delta_{S_{\theta\neq0}}}\sum_{l\in S_{\theta\neq0}} \frac{v_{lit}u_{lit}}{\sigma_{lit}} r_{lit}$), corrected by a factor of global risk valuation λ_i. Because r_{lit} depends on the CLIF cycles, for the center and semi-periphery countries, and that the return r_{nit} is also impacted by the cycles, this condition evolves throughout the changes of the CLIF cycles. If we assume that $\epsilon_{nl} = 0$ for all semi-periphery countries and that all center economies receive a certain level of investment (i.e., if $l \in S_c$ than $l \in S_{\theta\neq0}$), the condition for a semi-periphery country n becomes:

$$\theta_{nit}^* = 0 \quad \text{if} \quad u_{nit}\kappa_{nit} < \frac{1}{\delta_{S_{\theta\neq0}}}\left(\sum_{l\in S_{\theta\neq0}} \frac{v_{lit}u_{lit}}{\sigma_{lit}}\kappa_{lit} + \sum_{l\in S_c} \frac{v_{lit}u_{lit}}{\sigma_{lit}} f(A_{lt}) - \lambda_i\right). \quad \text{(A.44)}$$

This relation clearly indicates that during the upward phases of the CLIF cycles, when A_{lt}

[5] More specifically, considering $k \in S_{\theta=0}$ and $l \in S_{\theta\neq0}$, the stationary conditions for these two countries can be written as follows:

$$\zeta = h_k - \frac{\lambda}{\nu_k}\theta_k^* + \mu_k = h_l - \frac{\lambda}{\nu_l}\theta_l^* + \mu_l \quad \Leftrightarrow \quad h_k + \mu_k = h_l - \frac{\lambda}{\nu_l}\theta_l^* \quad \Leftrightarrow \quad \theta_l^* = \frac{\nu_l}{\lambda}h_l - \frac{\nu_l}{\lambda}(h_k + \mu_k). \quad \text{(A.40)}$$

This relation holds for all $l \in S_{\theta\neq0}$ such that we can sum the θ_l^* and obtain:

$$\sum_{l\in S_{\theta\neq0}} \theta_l^* = \sum_{l\in S_T} \theta_l^* = 1 = \sum_{l\in S_{\theta\neq0}} \frac{\nu_l}{\lambda}h_l - \sum_{l\in S_{\theta\neq0}} \frac{\nu_l}{\lambda}(h_k+\mu_k) \quad \Leftrightarrow \quad \lambda = \sum_{l\in S_{\theta\neq0}} \nu_l h_l - (h_k+\mu_k)\sum_{l\in S_{\theta\neq0}} \nu_l. \quad \text{(A.41)}$$

By isolating μ_k, we obtain Equation A.42.

are high, assuming a large synchronicity between these cycles, the inequality is more likely to be respected and the share of investment to a semi-periphery country n is therefore more likely to be zero, relative to a period of low values A_{lt}. So, not only the share of investment likely increases during the downward phases of the CLIF cycles (core of this study) but also the number of semi-periphery countries receiving financial funds from international investors.

Based on Equation A.42, we can note that

$$\sum_{k \in S_{\theta=0}} \nu_k \mu_k = - \sum_{k \in S_{\theta=0}} \nu_k h_k + \frac{\delta_{S_{\theta=0}}}{\delta_{S_{\theta\neq 0}}} \sum_{k \in S_{\theta\neq 0}} \nu_k h_k - \frac{\delta_{S_{\theta=0}}}{\delta_{S_{\theta\neq 0}}} \lambda, \tag{A.45}$$

with $\delta_{S_{\theta=0}} = \sum_{k \in S_{\theta=0}} \nu_k$. Therefore, by injecting this result for μ_k in Equation A.39, the solution to the optimization problem for θ_n^* with $n \in S_{\theta\neq 0}$ is given by:[6]

$$\theta_n^* = \frac{\nu_n}{\lambda} \left[h_n + \frac{1}{\delta_{S_{\theta\neq 0}}} \left(\lambda - \sum_{k \in S_{\theta\neq 0}} \nu_k h_k \right) \right]. \tag{A.46}$$

By coming back to the core paper notations, this relation becomes:

$$\theta_{nit}^* = \frac{v_{nit}}{\lambda_i \sigma_{nit}} \left[u_{nit} r_{nit} + \frac{1}{\delta_{S_{\theta\neq 0}}} \left(\lambda_i - \sum_{k \in S_{\theta\neq 0}} \frac{v_{kit} u_{kit}}{\sigma_{kit}} r_{kit} \right) \right]. \tag{A.47}$$

Relative to the focus of this study, that is the impact of the CLIF cycles on the investment share θ_{nit}^*, all of the main comments made in Section 2.3.1 still hold. In that regard, the main difference between Equations A.27 and A.47 is the presence of variations in θ_{nit}^* occurring due to changes in the number of countries receiving financial investments, through the terms $\delta_{S_{\theta\neq 0}}$ and the indices cover in the sum. On the one side, keeping the normalization that $\delta = 1$, we have that $\frac{1}{\delta_{S_{\theta\neq 0}}} > 1$ and converges toward one when the number of countries receiving funds increase. On the other side, the sum $\sum_{k \in S_{\theta\neq 0}} \frac{v_{kit} u_{kit}}{\sigma_{kit}} r_{kit}$ increases when the number of countries receiving financial funds increase. By decomposing

[6]Note that the term δ is simplified without requiring that it equals to one, as in the case without binding constraints.

the sum, for the term $\frac{1}{\delta_{S_{\theta \neq 0}}} \sum_{k \in S_{\theta \neq 0}} \frac{v_{kit} u_{kit}}{\sigma_{kit}} r_{kit}$, it can be shown that the second dynamic is more important, leading to an increase of the term when the number of countries increases. Therefore, if λ_i is not too large to dominate the trends, it is reasonable that during the downward phases of the CLIF cycles, the number of semi-periphery countries receiving financial investments from international investors increase and therefore increase the total share of investment going to the semi-periphery as a whole.

A.1.4 Financial investments and spatial model with N countries

This subsection highlights how the spatial regression model introduced in Section 2.2.2 can be derived from the solution to the optimization problem for the N-country model discussed in Subsection 2.3.1. I firstly derive this result for the case where the amount invested by the investors (q_{it} for investor i) are viewed as independent of the CLIF cycles, A_{mt}, such that by using the same notation that in Subsection 2.2.1 $q_{it} = \tilde{q}_{it}$. Secondly, I generalized this finding and consider that this amount, q_{it}, can be affected by any of the medium-term cycles of the center economies so that $q_{it} = \tilde{q}_{it} + \sum_{m \in S_c} g_{imt} A_{mt}$. For ease and simplicity, in both cases, I also assume that $0 < \theta^*_{nit} < 1$, $\forall n \in S_T$ such that the share of investment to the semi-periphery n, θ^*_{nit}, is given by Equation 2.9 or A.27. Moreover, I consider the normalization $\delta_{it} = 1$.

Case for q_{it} independent of A_{mt}. In this context (that is with $q_{it} = \tilde{q}_{it}$), the total of financial investments to the semi-periphery country n is given by:

$$\phi_{nt} = \sum_i q_{it} \theta^*_{nit} = \sum_i \tilde{q}_{it} \theta^*_{nit} \tag{A.48}$$

$$= \sum_i \tilde{q}_{it} \frac{v_{nit}}{\lambda_i \sigma_{nit}} (\lambda_i + u_{nit} \kappa_{nit} - \overline{\kappa}_{it}) + \sum_i \tilde{q}_{it} \frac{v_{nit}}{\lambda_i \sigma_{nit}} \sum_{m \in S_c} \omega_{nimt} f(A_{mt}). \tag{A.49}$$

The first term in the right-hand side of the equation can be interpreted as the set of factors that are independent of A_t. The second term in the right-hand side of the equation corresponds to the influence of the CLIF cycles on the financial investment. By highlighting the terms $f(A_mt)$, this equation can be rewritten as follows:

$$\phi_{nt} = \sum_i \tilde{q}_{it}\xi_{nit} + \sum_{m\in S_c}\left[\sum_i \tilde{q}_{it}\frac{v_{nit}}{\lambda_i\sigma_{nit}}\omega_{nimt}\right] f(A_{mt}). \tag{A.50}$$

with $\xi_{nit} = \dfrac{v_{nit}}{\lambda_i\sigma_{nit}}(\lambda_i + u_{nit}\kappa_{nit} - \overline{\kappa}_{it})$. After a lineralization (around 0) of the function f, this equation gives the following result:

$$\phi_{nt} = \sum_i \tilde{q}_{it}\xi_{nit} + \sum_{m\in S_c} w^*_{nmt}A_{mt} + \text{H.O.T.} \tag{A.51}$$

with $w^*_{nmt} = \sum_i \tilde{q}_{it}\dfrac{v_{nit}}{\lambda_i\sigma_{nit}}\omega_{nimt}f'$ and H.O.T. is the higher order terms from the linearization. Based on the representation of the financial investment to the semi-periphery country n, we can deduce (see below) the link between our model and DGP of the spatial model developed in Section 2.2.2.

Case for q_{it} dependent of A_{mt}. I consider now a scenario where q_{it} is more general and is affected by changes in the CLIF cycles. More specifically, based on the discussion in Subsection A.1.2, I define $q_{it} = \tilde{q}_{it} + \sum_{m\in S_c} g_{imt}(A_{mt})$, with $\frac{\partial \tilde{q}_{it}}{\partial A_{mt}} = 0$, $\forall\, m$, $g_{imt}(0) = 0$, $\forall\, m$, $\frac{\partial g_{ilt}}{\partial A_{mt}} > 0$, $\forall\, m = l$ and $\frac{\partial g_{ilt}}{\partial A_{mt}} = 0$, $\forall\, m \neq l$. As a result, the total of financial investments to the semi-periphery country n is given by:

$$\phi_{nt} = \sum_i q_{it}\theta^*_{nit} \tag{A.52}$$

$$= \sum_i \tilde{q}_{it}\xi_{nit} + \sum_i \tilde{q}_{it}\frac{v_{nit}}{\lambda_i\sigma_{nit}}\sum_{m\in S_c}\omega_{nimt}f(A_{mt}) \tag{A.53}$$

$$+ \sum_i\left[\sum_{m\in S_c} g_{imt}(A_{mt})\right]\xi_{nit} + \sum_i \frac{v_{nit}}{\lambda_i\sigma_{nit}}\left[\sum_{l\in S_c} g_{ilt}(A_{lt})\right]\left[\sum_{m\in S_c}\omega_{nimt}f(A_{mt})\right] \tag{A.54}$$

$$= \sum_i \tilde{q}_{it}\xi_{nit} + \sum_{m\in S_c}\Bigg\{\left[\sum_i \tilde{q}_{it}\frac{v_{nit}\omega_{nimt}}{\lambda_i\sigma_{nit}}\right] f(A_{mt}) + \left[\sum_i \xi_{nit}\right] g_{imt}(A_{mt}) + \left[\sum_i \frac{v_{nit}\omega_{nimt}}{\lambda_i\sigma_{nit}}\sum_{l\in S_c} g_{ilt}(A_{lt})\right] f(A \tag{A.55}$$

with $\xi_{nit} = \dfrac{v_{nit}}{\lambda_i \sigma_{nit}} \left(\lambda_i + u_{nit}\kappa_{nit} - \overline{\kappa}_{it}\right)$. As above, I linearize this function around 0 in order to obtain an expression directly depending on A_t. The linearization process gives the following equations:

$$\phi_{nt}(\boldsymbol{A}_t) = \phi_{nt}(0) + \sum_{m \in S_c} \frac{\partial \phi_{nt}}{\partial A_{mt}}_{|A_{mt}=0} (A_{mt} - 0) + \frac{1}{2} \sum_{m \in S_c} \frac{\partial^2 \phi_{nt}}{\partial A_{mt}^2}_{|A_{mt}=0} (A_{mt} - 0)^2 + \dots \tag{A.56}$$

$$= \sum_i \tilde{q}_{it}\xi_{nit} + \sum_{m \in S_c} \frac{\partial \phi_{nt}}{\partial A_{mt}}_{|A_{mt}=0} A_{mt} + \text{H.O.T.} \tag{A.57}$$

$$= \sum_i \tilde{q}_{it}\xi_{nit} + \sum_{m \in S_c} \left\{ \left[\sum_i \tilde{q}_{it} \frac{v_{nit}\omega_{nimt}}{\lambda_i \sigma_{nit}} \right] f'_{mt} + \left[\sum_i \xi_{nit} \right] g'_{imt} + 0 \right\} A_{mt} + \text{H.O.T.} \tag{A.58}$$

where H.O.T. is the higher order terms from the linearization. Finally we obtain the following result after simplification:

$$\phi_{nt} = \sum_i \tilde{q}_{it}\xi_{nit} + \sum_{m \in S_c} w^*_{nmt} A_{mt} + \text{H.O.T.} \tag{A.59}$$

with $w^*_{nmt} = f'_m \sum_i \tilde{q}_{it} \dfrac{v_{nit}\omega_{nimt}}{\lambda_i \sigma_{nit}} + g'_{imt} \sum_i \xi_{nit}$. Notably, ignoring the components in H.O.T., the only difference between Equations A.51 and A.59 in the presence of a term depending on g'_{imt} in the more general scenario. Based on this representation of the financial investment to the semi-periphery country n, we can deduce (see below) the link between our model and DGP of the spatial model developed in Section 2.2.2.

From a spatial representation to the DGP. The above paragraphs indicate that we can write the financial investments to the semi-periphery country n as follows

$$\phi_{nt} = \sum_i \tilde{q}_{it}\xi_{nit} + \sum_{m \in S_c} w^*_{nmt} A_{mt} + \text{H.O.T.} \tag{A.60}$$

with $\xi_{nit} = \frac{v_{nit}}{\lambda_i \sigma_{nit}} \left(\lambda_i + u_{nit}\kappa_{nit} - \overline{\kappa}_{it}\right)$ and $w^*_{nmt} = f'_m \sum_i \frac{\tilde{q}_{it} v_{nit}}{\lambda_i \sigma_{nit}} \left(u_{nit}\epsilon_{nm} - \overline{\epsilon}_{imt} - \frac{v_{mit} u_{mit}}{\sigma_{mit}} \right) + g'_{imt} \sum_i \xi_{nit}$. For this study, the key interest of this equation lies in the fact that it supports the empirical strategy implemented. Indeed, from an empirical perspective, it is clear that given the nature of the theoretical model any direct and reliable estimation of the key parameters necessary to derive ξ_{nit} and w^*_{nmt} (that is v_{nit}, λ_i, σ_{nit}, k_{nit}, u_{nit}, ϵ_{nm}, f'_m, g'_{imt}, etc.) is unrealistic. Rather, it is useful to define a DGP to conduct an empirical estimation of a factor reasonably proportional or linked to w^*_{nmt} in order to estimate its significance (to empirical confirm the hypothesis that CLIF cycles are significant drivers of financial investments to the semi-periphery) and its sign (to empirical assess whether or not the substitution effect is a dominant force relative to the volume effect and whether or not ϵ_{nit} are likely to be larger than 1).

On the one side, as implemented in conventional panel regression, we can estimate the term $\sum_i \tilde{q}_{it}\xi_{nit}$ (and potentially the H.O.T.) by country- and time-fixed effects as well as with domestic regressors (measures of GDP, etc.). On the other side, the weights w^*_{nmt} can be estimated by a TCM based on bilateral data between the semi-periphery country n and the center country m (international trade data, FDI, etc.), noted w_{nmt}. In that regard, the simplest approach consists in substituting w^*_{nmt} by w_{nmt} and mutliply the overall effect by a spatial coefficient ρ which could capture the significance and the sign of the affect, assuming that the designed TCM can reflect a relevant pattern of interaction. On this basis, assuming that the error terms, ε_{nt}, are independent and identically distributed random variables, the equation is equivalent to DGP of the spatial model developed in Section 2.2.2:

$$\phi_{nt} = \alpha_n + \tau_t + \beta X_{nt} + \rho \sum_{m \in S_c} w_{nmt} A_{mt} + \varepsilon_{nt} \tag{A.61}$$

where the H.O.T. from the linearization are included in the error terms.

A.2 Complements on data, indicators, and statistics

A.2.1 Indicators and evidence of CLIF cycles

Mainly due to data limitations, evidence of financial cycles has been almost exclusively estimated for only a few center countries. For this reason, medium-term cycles are only used here to characterize center leader economies, namely the US, Japan, France, the UK and Germany.[7] To construct the estimates, we used data provided by the BIS, the OECD, the World Bank, and the Federal Reserve Bank of Saint-Louis (Federal Reserve Economic Data).

Financial cycles are estimated by the medium-term average real (deflated by CPI) growth of (i) private banking credit to non-financial sector, (ii) private banking credit-to-GDP ratio, and (iii) residential property prices. Figures 2-2, 2-3 and 2-4 respectively exhibit the variables in 2020 US dollars and the medium-term growth rates used to build the financial cycles for the US.[8] We observe some periods of important increases in residential prices and in the amount of credit in the US, as well as some periods of large contractions. We also notice that medium-term fluctuations between these macroeconomic variables bear strong concordances.[9] We rely on a similar methodology to create estimates of industrial cycles. They are the average measure of the medium-term deviations (relative to and as percentage of the long-term trends) between (i) GCF (as percentage of the GDP), (ii) capacity utilization (in percent of the total production capacity), and (iii) unemployment rate (as percentage of the labor force). We apply a negative sign for the unemployment rate because of its predicted negative correlations with all other variables. Figures 2-5, 2-6 and 2-7 respectively exhibit the variables in 2020 US dollars and the medium-term deviations used to build the industrial cycles for the US. Similarly, we can

[7]See Appendices 1.2.3 and B.1 for theoretical and empirical details on the classification, respectiely.

[8]Similar charts can be found in Appendix 2.2.3 for Japan, the UK, Germany and France. Details on data used and the smoothing techniques can be found in the same appendix. This also concerns variables used to build the estimates of industrial cycles.

[9]Equity prices and aggregate asset prices do not fit the medium-term perspective well because of their large short-term components and are then not used. See Borio (2014) for details.

observe large concordances between these three macroeconomic indicators.

The financial and industrial cycles are the mean between their three respective subcomponents. Financial cycles represent an estimate of the medium-term growth rate of the financial sector in the economy. Industrial cycles measure the average medium-term deviation from the long-term trend of the production factors. The financial and industrial cycles for the US, Japan, Germany, the UK and France are respectively exhibited in Figure 2-8, 2-9, 2-10, 2-11 and 2-12. Table A.1 indicates the correlations between the financial and industrial cycles for the five center leader countries. The results indicate a high overall high concordance between the financial and industrial macroeconomic characterizations (particularly strong for the commonly used Pearson correlation). These high levels of correlation confirm the relevance of jointly analyzing the two medium-term cycles.

Indicators	US	Japan	UK	France	Germany	center leader
Pearson's corr.	0.79	0.44	0.39	0.66	0.61	0.73
Spearman's rank corr.	0.71	0.31	0.28	0.7	0.56	0.69
Kendall's rank corr.	0.51	0.22	0.21	0.5	0.4	0.52

Note: The largest p-value of the associated tests is lower than 10^{-4}.

Table A.1: Correlations between industrial cycles and financial cycles (1971-2019)

To construct univariate indicators for each medium-term cycle in center leader countries, the financial cycles (resp. industrial cycles) are estimated by computing the weighted average of the financial (resp. industrial) cycles of the center leader countries. The weights correspond to the average values of the current GDP for each country for the whole period (1971-2019).[10] Figure 2-13 displays the financial and industrial cycles obtained via this method. A high degree of concordance is noted; periods of industrial overcapacity match to a significant extent the periods of medium-term financial distress. The CLIF cycles are built by taking the means of the standardized values of the financial and industrial cycles of the center leader countries to avoid giving different weight to financial and industrial

[10]The US' industrial and financial cycles have the same weight in the aggregate indicators respectively. Both these weights are larger than those associated with the financial and industrial cycles of other center leader countries due to differences in terms of GDP among the countries.

dynamics. The univariate indicator is represented in Figure 2-1. The estimate signals five large drops in the activities of the center leader countries' financial and industrial sectors. The first two decreases appear during the first period and reveal the impact (among other factors) of the 1973 first oil shock and the 1979 Volcker monetary shock. The third period of overcapacity and financial distress in center leader countries happened at the beginning of the 1990s, marked by the burst of the Japanese bubble and recessions in the US and Europe. The fourth drop is much smaller and partially derived from the dot-com bubble at the beginning of the 2000s. The 2007-09 GFC is the global phenomenon at the root of the last large plunge exhibited by the indicator.

A.2.2 Empirical illustrations of the CLIF cycles

The components of the estimates for the financial and industrial cycles in the US are exhibited in the core of the study in Figures 2-2 to 2-7. In this appendix I provide similar figures for the four other center leader economies: Japan, the UK, Germany, and France. Specifically, the figures are organized as follows:

- for Japan, see Figures A-1 to A-6
- for the UK, see Figures A-7 to A-12
- for Germany, see Figures A-13 to A-18
- for France, see Figures A-19 to A-24

A.2.3 Additional graphs for aggregate results

This subsection provides additional results regarding the aggregate relations between various estimates of the financial and industrial cycles for center leader economies and financial flows to semi-periphery countries. Figure A-25 generalizes the results exhibited by Figure 2-14 with the decompositions of the financial and industrial cycles by countries.

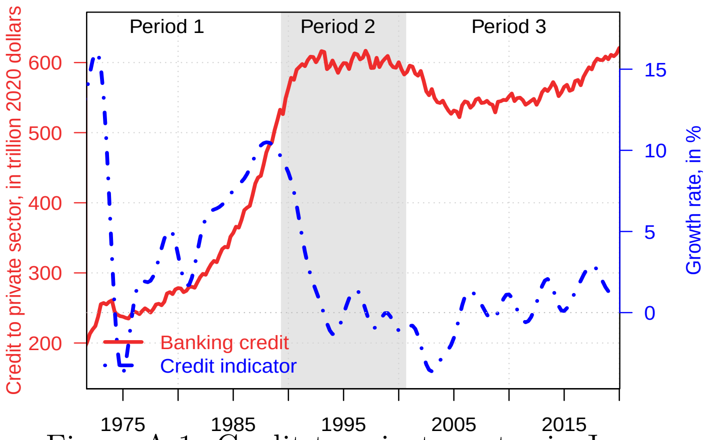

Figure A-1: Credit to private sector in Japan

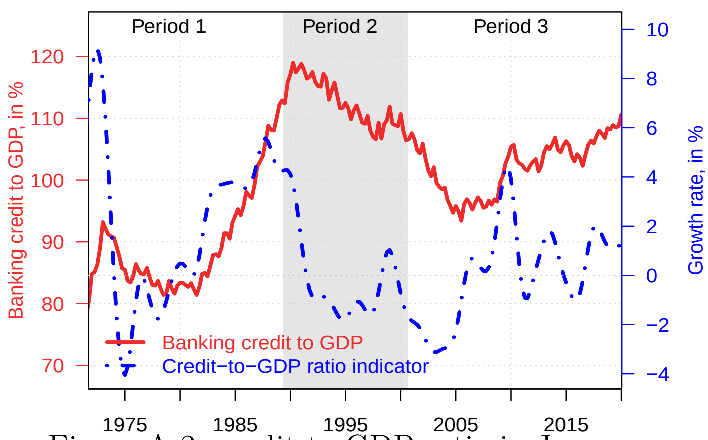

Figure A-2: credit-to-GDP ratio in Japan

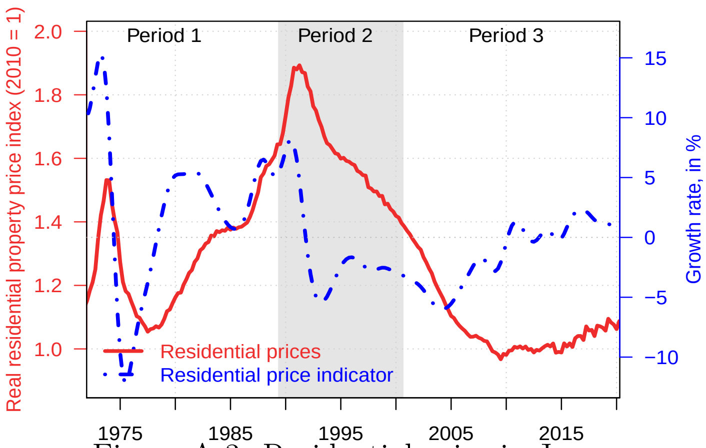

Figure A-3: Residential price in Japan

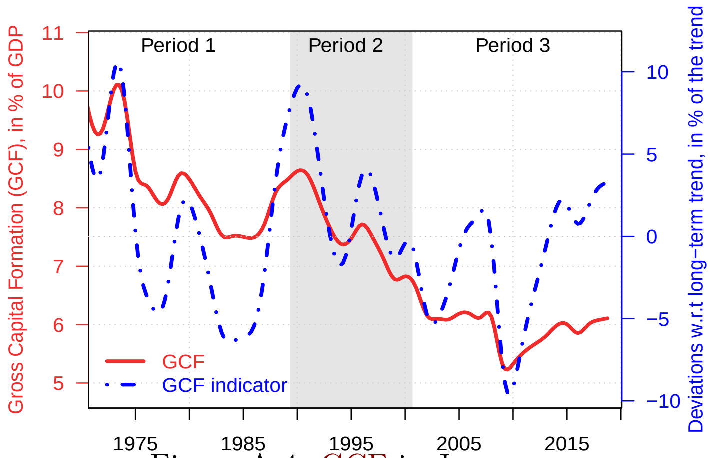

Figure A-4: GCF in Japan

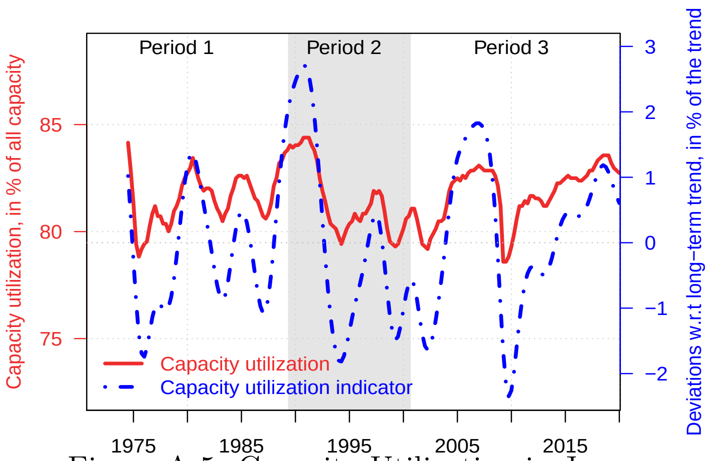

Figure A-5: Capacity Utilization in Japan

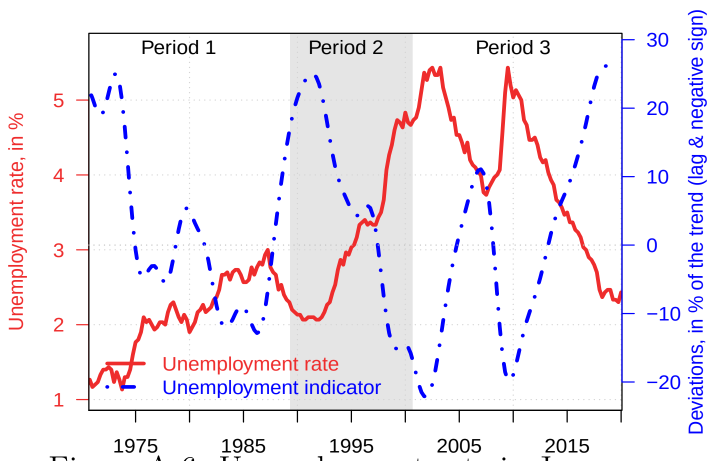

Figure A-6: Unemployment rate in Japan

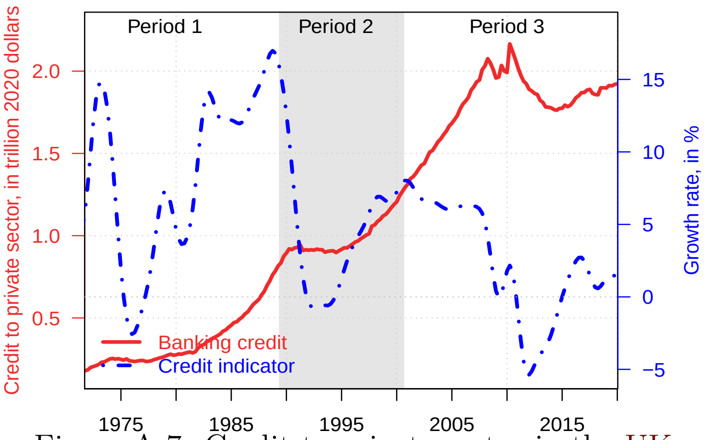

Figure A-7: Credit to private sector in the UK

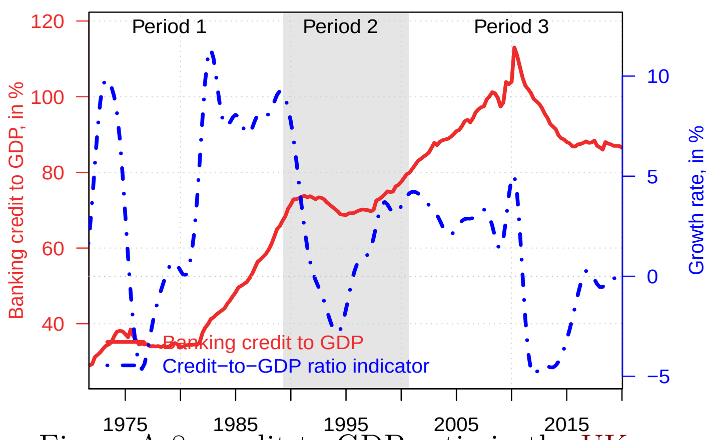

Figure A-8: credit-to-GDP ratio in the UK

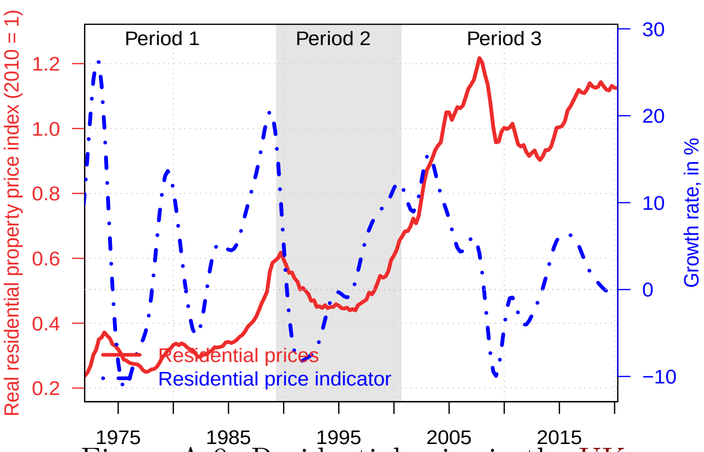

Figure A-9: Residential price in the UK

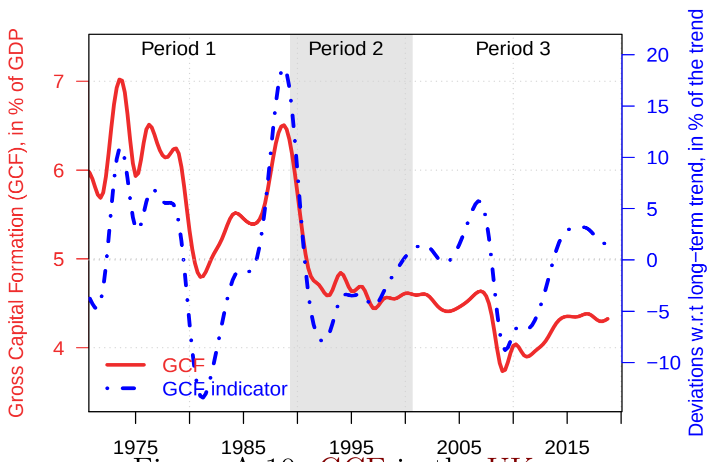

Figure A-10: GCF in the UK

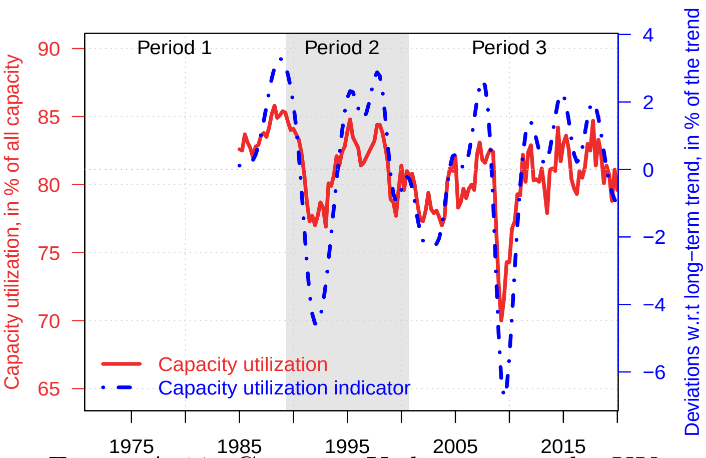

Figure A-11: Capacity Utilization in the UK

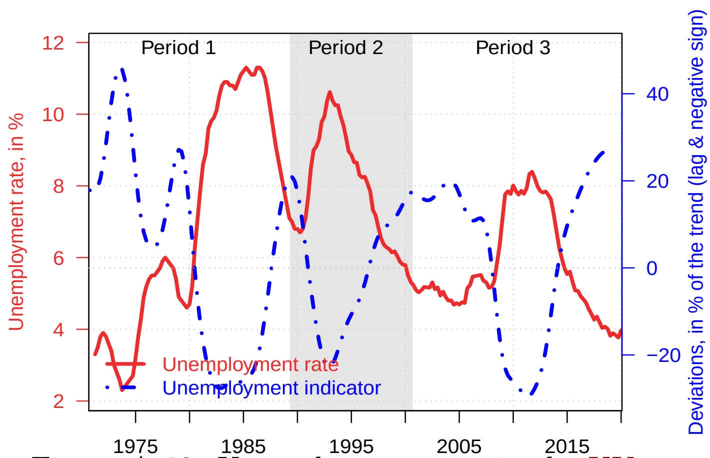

Figure A-12: Unemployment rate in the UK

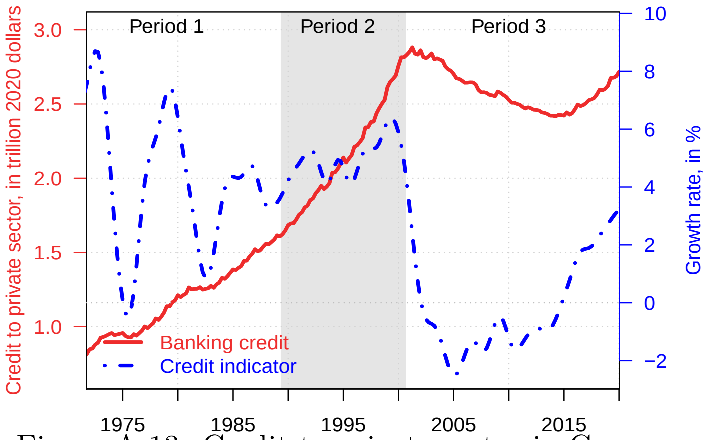

Figure A-13: Credit to private sector in Germany

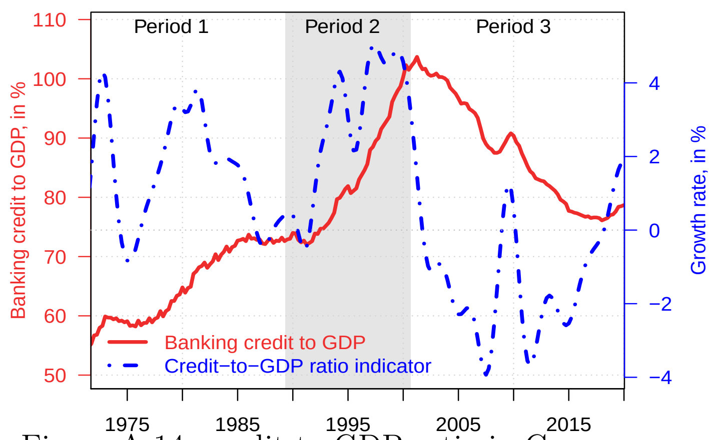

Figure A-14: credit-to-GDP ratio in Germany

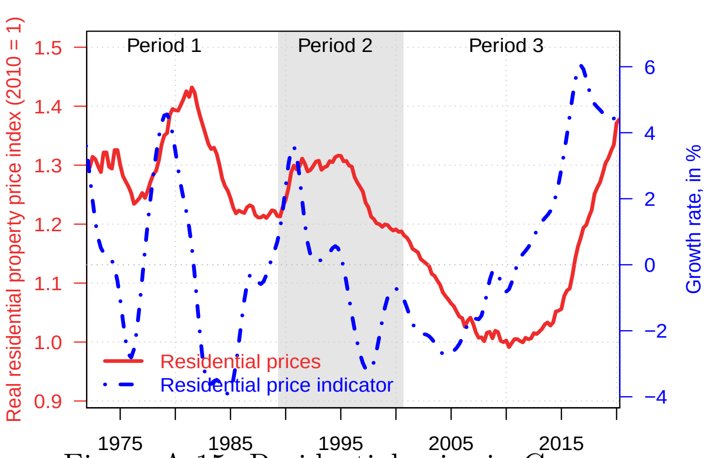

Figure A-15: Residential price in Germany

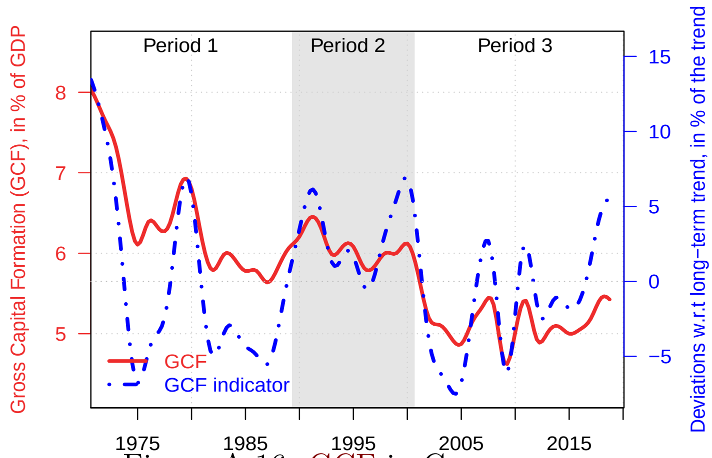

Figure A-16: GCF in Germany

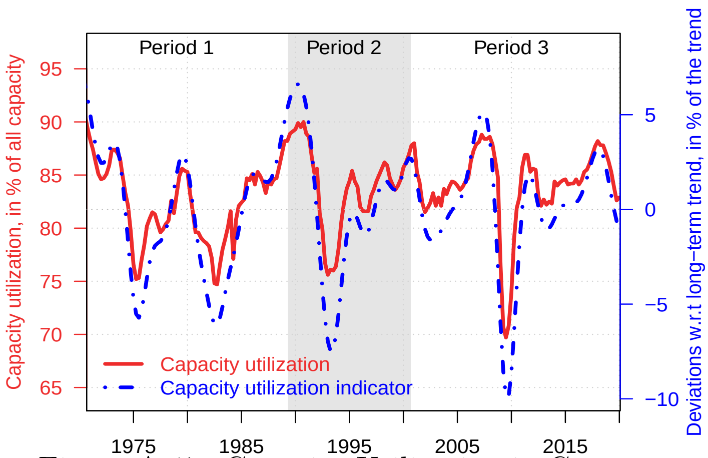

Figure A-17: Capacity Utilization in Germany

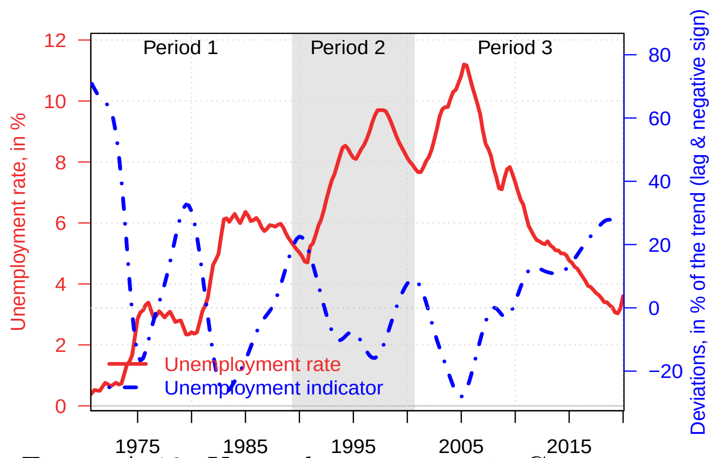

Figure A-18: Unemployment rate in Germany

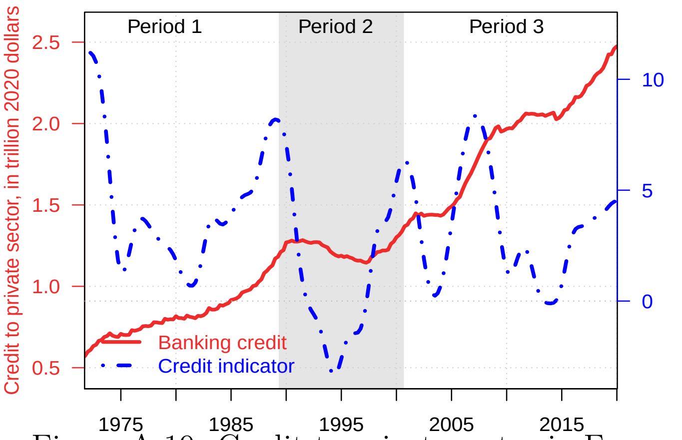

Figure A-19: Credit to private sector in France

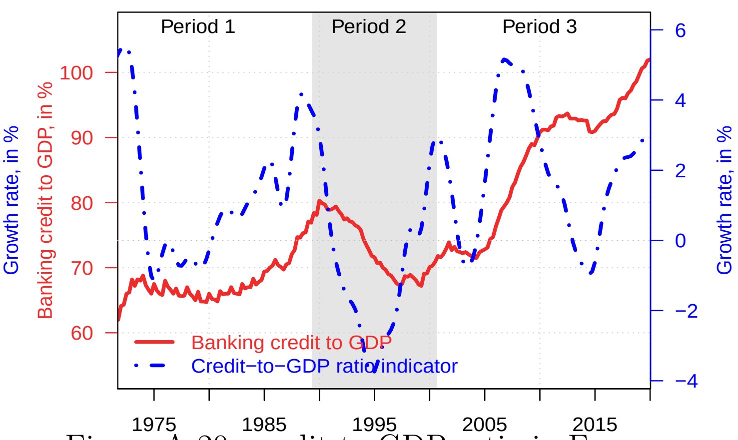

Figure A-20: credit-to-GDP ratio in France

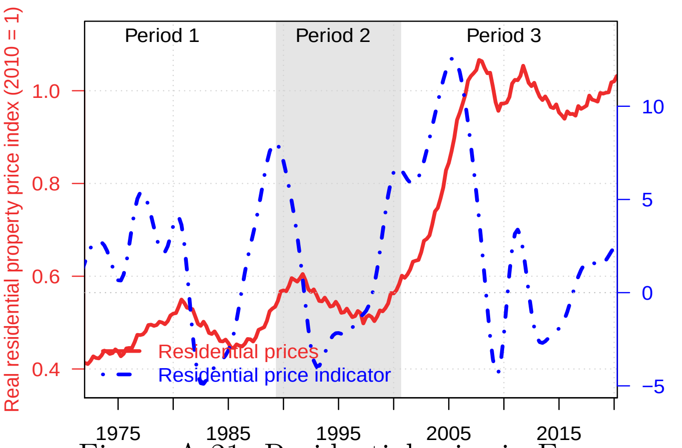

Figure A-21: Residential price in France

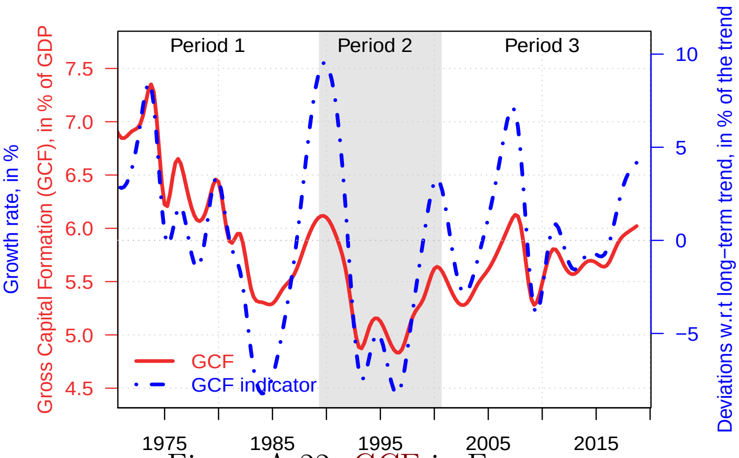

Figure A-22: GCF in France

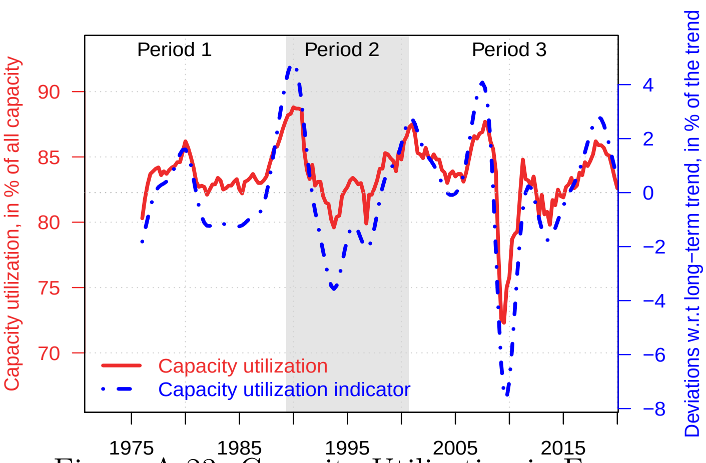

Figure A-23: Capacity Utilization in France

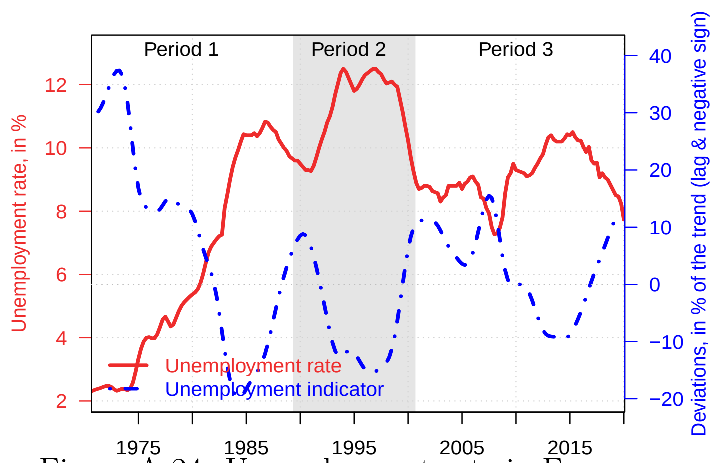

Figure A-24: Unemployment rate in France

Similarly, Figures A-26 and A-27 respectively display the Spearman's correlations and Kendall's correlations for the same estimates.

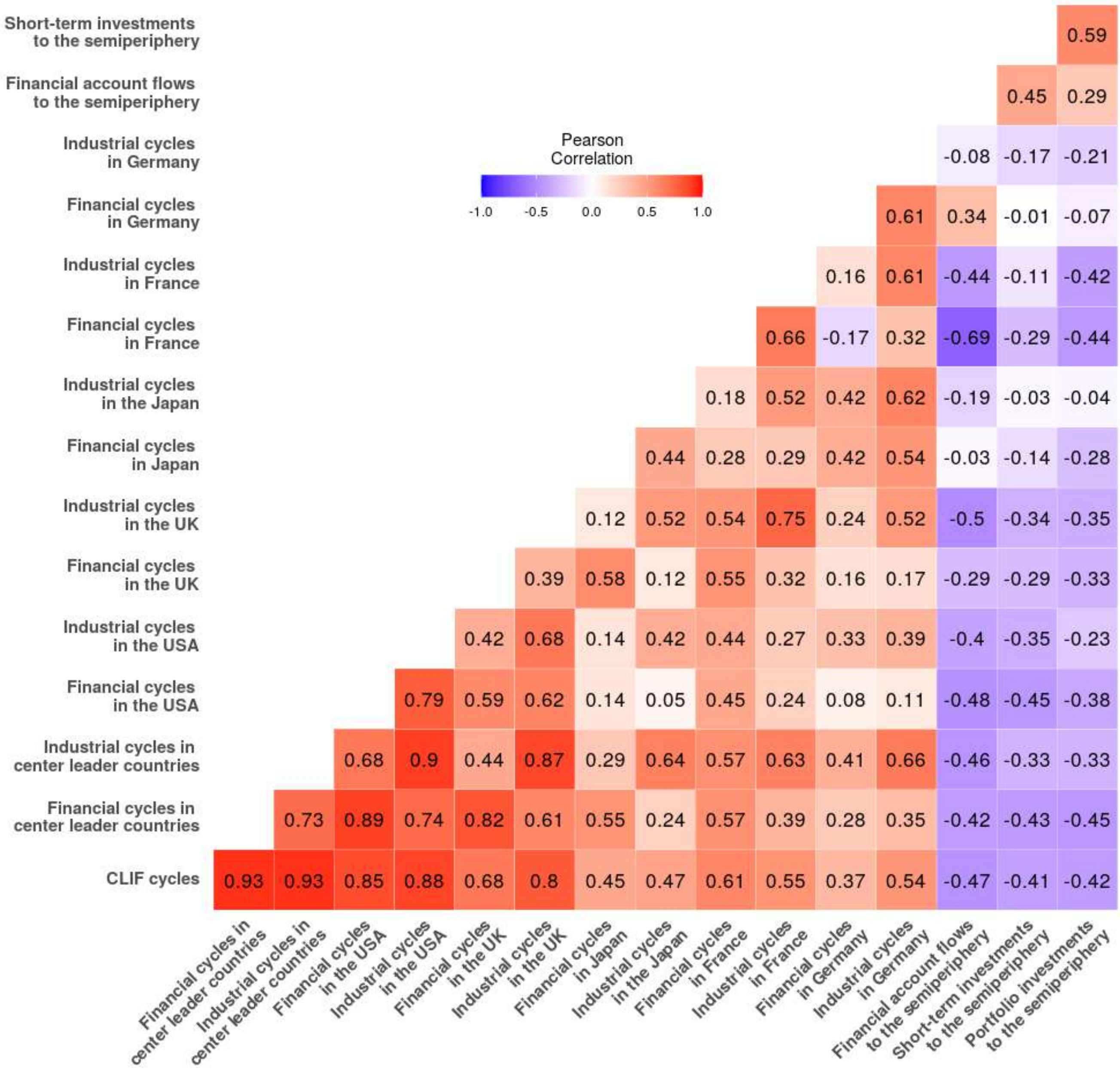

Figure A-25: Pearson's correlations for all center leader countries and countercyclicity with financial flows toward the semi-periphery

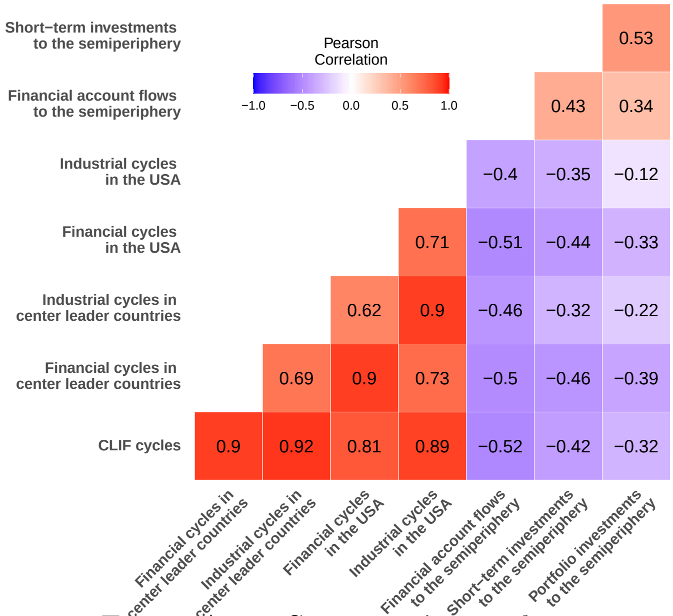

Figure A-26: Spearman's correlations

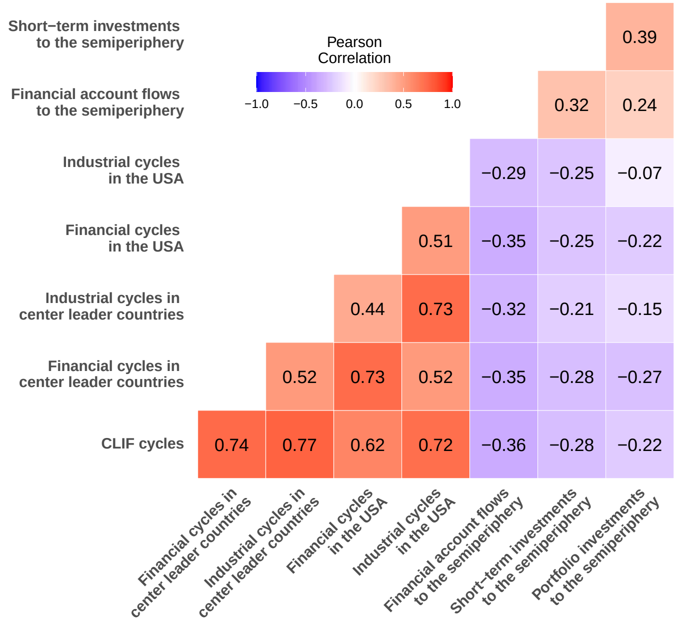

Figure A-27: Kendall's correlations

A.2.4 P-values and confidence intervals for correlation tests

	Financial cycles in center leader countries	Industrial cycles in center leader countries	Financial cycles in the USA	Industrial cycles in the USA	Financial account flows to the semiperiphery	Short-term investments to the semiperiphery	Portfolio investments to the semiperiphery
Short-term investments to the semiperiphery							1.69e-19
Financial account flows to the semiperiphery						4.85e-11	4.59e-05
Industrial cycles in the USA					3.26e-09	7.06e-07	1.15e-03
Financial cycles in the USA				3.19e-43	6.56e-13	4.76e-11	4.84e-08
Industrial cycles in center leader countries			3.38e-28	8.73e-66	5.06e-13	2.74e-06	3.39e-06
Financial cycles in center leader countries		1.71e-34	7.07e-68	2.85e-34	1.57e-10	3.01e-10	6.14e-11
CLIF cycles	2.74e-87	1.07e-86	1.88e-54	2.62e-62	6.19e-13	3.71e-09	1.52e-09

Figure A-28: P-values of the Pearson's correlation tests

	Financial cycles in center leader countries	Industrial cycles in center leader countries	Financial cycles in the USA	Industrial cycles in the USA	Financial account flows to the semiperiphery	Short-term investments to the semiperiphery	Portfolio investments to the semiperiphery
Short-term investments to the semiperiphery							[0.46 ; 0.7]
Financial account flows to the semiperiphery						[0.29 ; 0.58]	[0.11 ; 0.45]
Industrial cycles in the USA					[-0.54 ; -0.24]	[-0.5 ; -0.17]	[-0.4 ; -0.05]
Financial cycles in the USA				[0.71 ; 0.85]	[-0.61 ; -0.33]	[-0.59 ; -0.29]	[-0.53 ; -0.21]
Industrial cycles in center leader countries			[0.57 ; 0.77]	[0.83 ; 0.91]	[-0.61 ; -0.33]	[-0.48 ; -0.15]	[-0.48 ; -0.15]
Financial cycles in center leader countries		[0.64 ; 0.81]	[0.84 ; 0.92]	[0.63 ; 0.81]	[-0.57 ; -0.28]	[-0.57 ; -0.27]	[-0.58 ; -0.29]
CLIF cycles	[0.9 ; 0.95]	[0.9 ; 0.95]	[0.78 ; 0.89]	[0.82 ; 0.91]	[-0.61 ; -0.33]	[-0.55 ; -0.24]	[-0.56 ; -0.25]

Figure A-29: Confidence intervals of the Pearson's correlation tests for $\alpha = 5\%$

	Financial cycles in center leader countries	Industrial cycles in center leader countries	Financial cycles in the USA	Industrial cycles in the USA	Financial account flows to the semiperiphery	Short-term investments to the semiperiphery	Portfolio investments to the semiperiphery
Short-term investments to the semiperiphery							[0.49 ; 0.68]
Financial account flows to the semiperiphery						[0.33 ; 0.55]	[0.15 ; 0.41]
Industrial cycles in the USA					[-0.51 ; -0.28]	[-0.46 ; -0.22]	[-0.36 ; -0.09]
Financial cycles in the USA				[0.73 ; 0.84]	[-0.58 ; -0.37]	[-0.56 ; -0.33]	[-0.5 ; -0.25]
Industrial cycles in center leader countries			[0.6 ; 0.75]	[0.84 ; 0.91]	[-0.58 ; -0.37]	[-0.45 ; -0.2]	[-0.45 ; -0.2]
Financial cycles in center leader countries		[0.66 ; 0.79]	[0.86 ; 0.92]	[0.66 ; 0.79]	[-0.54 ; -0.32]	[-0.54 ; -0.31]	[-0.55 ; -0.33]
CLIF cycles	[0.91 ; 0.95]	[0.91 ; 0.95]	[0.8 ; 0.88]	[0.83 ; 0.9]	[-0.58 ; -0.37]	[-0.52 ; -0.28]	[-0.53 ; -0.29]

Figure A-30: Confidence intervals of the Pearson's correlation tests for $\alpha = 1\%$

	Financial cycles in center leader countries	Industrial cycles in center leader countries	Financial cycles in the USA	Industrial cycles in the USA	Financial account flows to the semiperiphery	Short-term investments to the semiperiphery	Portfolio investments to the semiperiphery
Short-term investments to the semiperiphery							0.00e+00
Financial account flows to the semiperiphery						5.64e-10	1.99e-06
Industrial cycles in the USA					1.91e-08	5.02e-07	1.10e-01
Financial cycles in the USA				0	0	2.93e-10	3.37e-06
Industrial cycles in center leader countries			0	0	0	7.74e-06	2.61e-03
Financial cycles in center leader countries		0	0	0	0	1.32e-11	2.04e-08
CLIF cycles	0	0	0	0	0	2.36e-09	8.26e-06

Figure A-31: P-values of the Spearman's correlation tests

	Financial cycles in center leader countries	Industrial cycles in center leader countries	Financial cycles in the USA	Industrial cycles in the USA	Financial account flows to the semiperiphery	Short-term investments to the semiperiphery	Portfolio investments to the semiperiphery
Short-term investments to the semiperiphery							1.30e-15
Financial account flows to the semiperiphery						4.89e-11	5.44e-07
Industrial cycles in the USA					3.24e-09	3.41e-07	1.23e-01
Financial cycles in the USA				4.81e-26	1.97e-13	1.71e-07	3.84e-06
Industrial cycles in center leader countries			8.68e-20	2.9e-47	2.4e-13	9.25e-06	2.00e-03
Financial cycles in center leader countries		4.66e-28	4.27e-51	2.18e-26	6.88e-14	5.53e-09	2.13e-08
CLIF cycles	3.31e-55	1.24e-58	4.43e-38	9.11e-49	1.32e-14	1.19e-08	4.96e-06

Figure A-32: P-values of the Kendall's correlation tests

A.2.5 Countercyclicity between CLIF cycles cycles and financial flows towards the semi-periphery

Subsection 3.2.2 argues that financial and industrial cycles in center economies trigger a pattern of cyclical financial flows between the center and the semi-periphery. During the downward phase of the CLIF cycles, investors of center countries, searching to new profitable productive investments and/or attracted by larger short-term yields for their financial investments, allocate a larger part of their investments to semi-periphery countries (mainly within a few financial hot spots). This leads to large financial inflows to the semi-periphery. Subsequently, several international and/or domestic push factors reverse the process; large financial flows leave the semi-periphery. Overall, the financial flows towards the semi-periphery are countercyclical relative to financial and industrial medium-term cycles in the center.

To statistically test this hypothesis of countercyclicity, we use various estimates. Indicators of financial and industrial cycles and their construction are presented above. Given the significance and the temporal changeability of financial hot spots for international investors, the model can only be easily assessed by considering the semi-periphery as a whole. Therefore, the estimates of financial flows require a set of countries defined as semi-periphery countries. This is made using the classification introduced in Subsection 1.2.3 and Appendix B.1.[11] We used the IMF's Balance of Payments and International Investment Position dataset to estimate financial flows to the semi-periphery. Three measures are built. The first indicator sums up all net financial flows accounted in the available financial accounts in the semi-periphery. Second, net portfolio investments towards the semi-periphery are viewed as a direct estimator. A third estimate is built, named *short-term investments*, which consists of the addition of net portfolio investments,

[11]For center leader and semi-periphery countries, assessments presented in this subsection only include countries that haven't transitioned from one category to another. For example, this method excludes South Korea from the sample as, given its macroeconomic characteristics, the country was part of the semi-periphery during the first subperiod but part of the center for the last subperiod. The list of countries for each period is provided in Appendix B.1.

net "other investments" (including debt instruments), and net financial derivatives (other than reserves) and employee stock options.[12]

The use of these indicators relies on three main hypotheses. Firstly, we assume a correct accounting and registration of financial flows among semi-periphery countries during the period. This hypothesis is particularly important as we assume that cross-country investments inside the semi-periphery cancel each other out such that we measure through these indicators flows from the rest of the world. It also implies that errors and omissions in balance of payment data and the impacts of tax havens are not sufficiently strong to alter the patterns in the indicators.[13] This hypothesis also implies that current accounts are assumed to properly measure the trade balance, net primary income, and net unilateral transfers (considered too small to play a major role). In other words, we hypothesize that net current account flows do not incorporate major net investments from the center to the semi-periphery (for instance, through transfer pricing techniques), or at least that these transfers through current account transactions have a common pattern with the three used indicators of financial flows. Secondly, in line with Hypothesis 3.3, we assume that foreign investments from the center represent the larger part of foreign investments toward the semi-periphery. It is quite clear that the periphery does not distort the pattern, but the impact of China in recent years (particularly after the GFC) can be more serious.[14] Thirdly, we assume that sample biases do not alter the statistical results. These biases originate from both the lack of data for some semi-periphery countries for some periods (particularly important for Eastern European countries before the early 1990s)

[12]Other investments are particularly important for the first period (see Figure 3-5). They allow the inclusion of large bank loans. Derivative investments are less important and the results are not significantly affected by the inclusion or exclusion of this category of financial product. Importantly, FDI flows in themselves are viewed as significantly affected by longer-term industrial integration and are not considered. As a consequence, we don't have robust negative correlations between financial and industrial cycles in center leader economies and FDI investments.

[13]For example, an underlying hypothesis is the absence of a procyclical or countercyclical pattern in the use by center economies of semi-periphery countries as offshore intermediate vehicles for their investment strategies in a third destination with one of the two flows not properly recorded. This could artificially increase or decrease the statistical relationships between the indicators, but not change the overall pattern.

[14]However, for the sake of simplicity, we will assume that, even if Chinese investments abroad rose sharply, their investment strategy followed the same logic and that therefore the potential bias is small.

and the intrinsically dynamic (and not static) nature of the center-periphery model as well as potential miss-classifications of some semi-periphery countries. Based on our robustness checks (see below), the most plausible major impact of the set of sample biases is that financial flows to the semi-periphery before the debt crisis can be underestimated. Given the long-term perspective and the number of countries involved (and the need for international comparability), despite the above-mentioned imperfections, these indicators of financial investments are regarded as the best ways to estimate the pattern of financial flows to semi-periphery countries.

Figure 2-1 exhibits the indicators of CLIF cycles and financial account flows. We observe the overall countercyclical nature of the two estimates (correlation: -0.47). Investments surged to semi-periphery countries before a drop in CLIF cycles at the beginning of the 1980s, subsequently triggering financial outflows. The same pattern happened during the 1990s and between 2008-14. We see that each subperiod (periods 1, 2, and 3 on the chart) is characterized by massive financial inflows followed by an abrupt drop. These three periods of abrupt rises and then plunges in financial flows towards the semi-periphery correspond to the three waves of financial crises that affected semi-periphery countries, introduced in Subsection 3.3.

A more quantitative and broader assessment of the countercyclical dynamics is provided by Figure 2-14 displaying the Pearson's correlations between different key estimates. We first note that major components of the CLIF cycles (industrial and financial in center leader countries or in the US), as suggested by Table A.1, are highly correlated to each other. We also observe significant correlations between the three indictors of financial flows towards the semi-periphery. More importantly, large and significant negative correlations are measured between the estimates of financial flows and those of medium-term cycles.[15] The overall procyclicity between medium-term cycles in the center and their respective countercyclicity with the financial flows to the semi-periphery are highlighted

[15] The lowest p-value associated with all these correlations is below 0.2 %. If we include Spearman's and Kendall's ranking correlation tests, the lowest p-value is below 1.3 %. The highest p-value is 1.23 % for the Kendall's correlation between the industrial cycles in the US and portfolio investments towards the semi-periphery. See details in Appendix A.2.4

with the colors associated with the correlation levels. Finally, we observe that financial cycles (in the US or the weighted average among center leader countries) have in general a slightly larger negative correlation with financial flows, and in particular for portfolio investments. These statistical measures, and in particular their magnitude, robustness (see below) and statistical significance, confirm the theoretical countercyclicity hypothesis presented in Subsection 3.2.2.

A.3 Robustness analysis

Several robustness checks were performed. Different normalizations were tested for each subcomponent of the industrial and financial cycles. We assessed the impact of standardizing (minus the mean and divided by the standard deviation) each subcomponent, dividing the indicator by their respective long-term trends, or keeping the growth rate. Each configuration provides similar results. Different smoothing techniques were tested: bandpass filter (for example, based on the Fourier decomposition), Nadarya-Watson estimates, polynomial regression, and Kalman filter. The results are robust to changes in smoothing technique (between different techniques and within techniques with different metaparameters - up to certain limits). Similar patterns and correlations are observed by only using subsets of the indicators used to build financial and industrial cycles (for example, by only using GCF and capital utilization, without unemployment rate, for the industrial cycles). The substitution of several variables by close but different estimates were also evaluated.[16] The statistical results are marginally affected by these specification changes. Different weights between industrial and financial cycles as well as between countries to build the indicator of the CLIF cycles were tested (current GDP, GDP in PPP, total amount of credit in the economy, etc.). The results are robust to these changes. Incremental changes in the classification of countries (center leader and semi-periphery countries) do not modify the main conclusions. The inclusion of Canada and/or Italy in

[16] For example, this includes the use of gross fixed capital formation as a substitute for GCF, total private credit as a substitute for total banking private credit, etc. These variables are usually highly correlated.

the set of center leader countries does not alter the overall results and the countercyclical hypothesis is robust to this alternative specification. Different sets of countries were tried for the semi-periphery as well. For example, a time-varying sample (a different set of countries for each of the three periods) were tested and no major change in results were observed (as long as China is not included for the last period). The impact of a potential sample bias was assessed (for example, by including only countries for which we have data since 1977), and our results are also resilient in this sense. Figures A-33 and A-34 provide estimates confirming that the presence of a sample bias is not likely to change the countercyclical relation between the inflows to the semi-periphery and CLIF cycles. In all cases, we observed a high level of procyclicity between medium-term cycles of center leader countries and a high level of countercyclicity between these medium-term cycles and financial flows to the semi-periphery.[17]

Sample bias

The indicators used for the measures of financial flows rely on the assumption that no sample biases do alter the statistical results. These biases can originate from both the lack of data for some semi-periphery countries for some periods (particularly important for Eastern European countries before the early 1990s) and the intrinsically dynamic (and not static) nature of the center-periphery model as well as potential miss-classifications of some semi-periphery countries. Based on our robustness checks, the most plausible major impact of the set of potential sample biases is that financial flows to the semi-periphery before the debt crisis can be underestimated. This is certainly true for portfolio investments, as most transactions to semi-periphery were bank loans during that period.

[17] Two major exceptions exist and are worth mentioning. The results suggest that the financial cycles between France and Germany are not procyclical and that the financial cycles in Germany and Japan are not countercyclical with financial flows to the semi-periphery. However, this does not change the overall theoretical and empirical conclusions. The empirical results for the different configurations and details on the tests are available upon request.

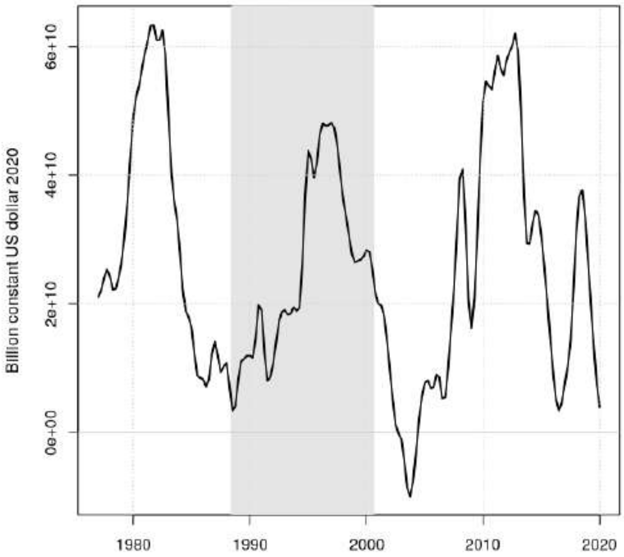

Figure A-33: Estimate of Financial Account flows to Semi-periphery, based on data available since 1977

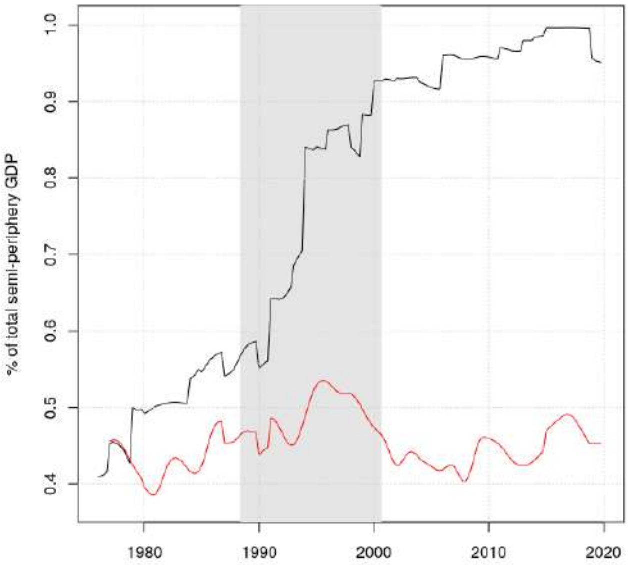

Figure A-34: Share of semi-periphery countries' GDP for which data are available and for which data are available since 1977

A.3.1 Additional tables for the semi-periphery

This subsection provides additional tables of results on the tests discussed in Sections 2.2.4, 2.2.5, 2.3.4 and 2.4. Table A.2 displays results for DGP 1 with various regressors, which confirms that the core results are independent of these regressors. Table A.3 provides the results for DGP 2 with A_t and without normalizations of W^{geo} and W_t^{cur}. Main results for DGP 2 and 2' for the semi-periphery with short-term financial flows, with unweighted cycles and without normalization for W_t^{cur} and W^{geo}, are exhibited by Table A.4. Table A.5 provide results for DGP 1 for the semi-periphery with short-term financial flows with an AR(1) process. This confirms that the presence of correlation does not impact the core interpretation of the results. Table A.6 is the equivalent for DGP 2.

	medium-term cycles							
A_t	-75.2**	-88.4**	-92.5**	-83.4**				
	(0.025)	(0.015)	(0.015)	(0.024)				
A_t^{fin}					-159*	-266**	-268**	-274**
					(0.061)	(0.016)	(0.016)	(0.013)
A_t^{ind}					61	140**	140**	155**
					(0.22)	(0.031)	(0.029)	(0.016)
CFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TFE	No	No	No	No	No	No	No	No
Regressors	No	De	DeEc	DeEcEx	No	De	DeEc	DeEcEx
R^2	0.0052	0.045	0.046	0.068	0.01	0.06	0.062	0.085
Log-likelihood	-57244	-57105	-57100	-57019	-57226	-57049	-57044	-56957
N	6838	6838	6838	6838	6838	6838	6838	6838

	GDP-weighted medium-term cycles							
A_t×GDP	-72.3**	-74***	-75.1***	-72.4**				
	(0.01)	(0.0075)	(0.007)	(0.012)				
A_t^{fin}×GDP					-149***	-183***	-186***	-212***
					(0.0016)	(0.0003)	(0.00028)	(2.2e-05)
A_t^{ind}×GDP					60.6**	90.7***	93***	121***
					(0.037)	(0.0025)	(0.0022)	(3.7e-05)
CFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TFE	No	No	No	No	No	No	No	No
Regressors	No	De	DeEc	DeEcEx	No	De	DeEc	DeEcEx
R^2	0.023	0.061	0.063	0.085	0.05	0.1	0.11	0.14
Log-likelihood	-57183	-57045	-57038	-56958	-57085	-56882	-56874	-56730
N	6838	6838	6838	6838	6838	6838	6838	6838

Table A.2: Results for DGP 1 for the semi-periphery with short-term financial flows and various regressors.

A_t refers to the estimates of the CLIF cycles and A^{fin} (respectively A_t^{ind}) represents an average of the medium-term financial (resp. industrial) cycles of the center leader countries. Financial flows considered here are portfolio investments and other investments in the balance of payments (to incorporate bank loans). GDP-weighted medium-term cycles indicates that the medium-term cycles on these columns are multiply by the real GDP of the economies that they are impacting, to capture of the size of these economies. CFE and TFE respectively stands for country and time fixed effects. De and DeEc informs that only demographic and demographic and some fundamental economic variables are used as regressors. DeEcEx indicates that demographic and extended economic regressors are used as control variables.
The main observation from this table is that the results introduced in Table 2.2 are robust to different specifications, by multiplying the cycles by a "scale" factor (such as the GDP) or by introducing different regressors in the model.

	No Time Fixed Effects		With Time Fixed Effects	
$A_t^{fin} \times$ GDP$_t$	-138***		-130***	
	(0.00092)		(9.5e-05)	
$W_t^{fin} A_t$	-124***		-107***	
	(0.00086)		(0.0026)	
$W_t^{trade} A_t$	85.3***		87.5***	
	(2.7e-08)		(7.7e-09)	
$W_t^{cur} A_t$	69.5		65.9	
	(0.16)		(0.17)	
$W_t^{geo} A_t$	242**		233**	
	(0.041)		(0.019)	
$A_t^{fin} \times$ GDP$_t$		-194***		-215***
		(0.00012)		(8.9e-07)
$A_t^{ind} \times$ GDP$_t$		78.3**		90.2***
		(0.029)		(0.0082)
$W_t^{fin} A_t^{fin}$		-240**		-225*
		(0.025)		(0.061)
$W_t^{fin} A_t^{ind}$		109		102
		(0.31)		(0.39)
$W_t^{trade} A_t^{fin}$		141***		153**
		(0.0099)		(0.023)
$W_t^{trade} A_t^{ind}$		-42.1		-32
		(0.36)		(0.51)
$W_t^{cur} A_t^{fin}$		-11.6		-50.1
		(0.9)		(0.52)
$W_t^{cur} A_t^{ind}$		-21.3		-12.7
		(0.56)		(0.72)
$W_t^{geo} A_t^{fin}$		241*		251*
		(0.079)		(0.069)
$W_t^{geo} A_t^{ind}$		32.6		35.7
		(0.63)		(0.56)
CFE	Yes	Yes	Yes	Yes
TFE	No	No	Yes	Yes
Regressors	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.11	0.17	0.088	0.13
Log-likelihood	-39264	-39098	-38992	-38877
N	4670	4670	4670	4670

Table A.3: Estimates of DGP 2 for the semi-periphery with short-term financial flows with GDP-weighted W_t^{cur} and W^{geo}

	No Time Fixed Effects		With Time Fixed Effects	
A_t	-120**			
	(0.029)			
$W_t^{fin} A_t$	-161***		-173***	
	(0.0005)		(0.00017)	
$W_t^{trade} A_t$	160***		158***	
	(4.2e-12)		(1.5e-13)	
$W_t^{cur} A_t$	91.1		502	
	(0.35)		(0.11)	
$W_t^{geo} A_t$	127		22.8	
	(0.11)		(0.79)	
A_t^{fin}		-200**		
		(0.042)		
A_t^{ind}		111*		
		(0.07)		
$W_t^{fin} A_t^{fin}$		-369***		-379***
		(0.00082)		(0.00037)
$W_t^{fin} A_t^{ind}$		168***		143**
		(0.0027)		(0.018)
$W_t^{trade} A_t^{fin}$		200***		186***
		(2.6e-05)		(9.1e-05)
$W_t^{trade} A_t^{ind}$		-41.6		-24.5
		(0.18)		(0.43)
$W_t^{cur} A_t^{fin}$		23.3		766**
		(0.88)		(0.038)
$W_t^{cur} A_t^{ind}$		-81.8		-148
		(0.15)		(0.24)
$W_t^{geo} A_t^{fin}$		344**		225
		(0.029)		(0.17)
$W_t^{geo} A_t^{ind}$		-79.2		-51.6
		(0.18)		(0.37)
CFE	Yes	Yes	Yes	Yes
TFE	No	No	Yes	Yes
Regressors	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.089	0.15	0.073	0.12
Log-likelihood	-39323	-39154	-39032	-38916
N	4670	4670	4670	4670

Table A.4: Main results for DGP 2 and 2' for the semi-periphery with short-term financial flows; with unweighted cycles and without normalization for W_t^{cur} and W^{geo}

	CLIF cycles		GDP-weighted CLIF cycles	
A_t	-55**		-48.2***	
	(0.012)		(0.0047)	
A_t^{fin}		-230***		-178***
		(0.011)		(9e-05)
A_t^{ind}		142**		109***
		(0.017)		(0.00023)
lag	0.277***	0.266***	0.263***	0.226***
	(0.0016)	(0.0021)	(0.0016)	(0.0046)
CFE	Yes	Yes	Yes	Yes
TFE	No	No	No	No
Regressors	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.14	0.15	0.14	0.19
Log-likelihood	-54422	-54376	-54395	-54231
N	6551	6551	6551	6551

Table A.5: Main results for DGP 1 for the semi-periphery with short-term financial flows with an AR(1) process.

	No Time Fixed Effects		With Time Fixed Effects	
$A_t^{fin} \times$ GDP$_t$	-102**		-106***	
	(0.018)		(0.002)	
$W_t^{fin} A_t$	-99***		-80.9**	
	(0.0017)		(0.017)	
$W_t^{trade} A_t$	74.2***		77.2***	
	(1.4e-08)		(3.7e-09)	
$W_t^{cur} A_t$	77.8*		77.1*	
	(0.096)		(0.06)	
$W_t^{geo} A_t$	166		176**	
	(0.14)		(0.043)	
$A_t^{fin} \times$ GDP$_t$		-163***		-181***
		(0.0026)		(3.4e-05)
$A_t^{ind} \times$ GDP$_t$		72.3*		75.8**
		(0.054)		(0.015)
$W_t^{fin} A_t^{fin}$		-212**		-180*
		(0.032)		(0.059)
$W_t^{fin} A_t^{ind}$		106		79.8
		(0.32)		(0.45)
$W_t^{trade} A_t^{fin}$		121**		115*
		(0.029)		(0.063)
$W_t^{trade} A_t^{ind}$		-29.3		-10.6
		(0.5)		(0.81)
$W_t^{cur} A_t^{fin}$		-14.1		-25.8
		(0.83)		(0.7)
$W_t^{cur} A_t^{ind}$		-19		-4.53
		(0.52)		(0.88)
$W_t^{geo} A_t^{fin}$		190		217*
		(0.12)		(0.083)
$W_t^{geo} A_t^{ind}$		18.8		15.8
		(0.8)		(0.81)
lag	0.221**	0.183*	0.196**	0.174**
	(0.042)	(0.061)	(0.029)	(0.045)
CFE	Yes	Yes	Yes	Yes
TFE	No	No	Yes	Yes
Regressors	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.15	0.19	0.13	0.15
Log-likelihood	-37630	-37516	-37354	-37290
N	4485	4485	4485	4485

Table A.6: Estimates of DGP 2 and 2' for the semi-periphery with short-term financial flows, with an AR(1) process and GDP-weighted W_t^{cur} and W^{geo}

A.3.2 Heterogeneity among financial flows and countries

Table A.7 exhibits the estimates for DGP 1 when considering all financial flows of the financial account, only portfolio flows or FDI. Tables A.8 and A.9 display estimates for DGPs 1 and 2 for follower center economies and periphery countries.

	CLIF cycles		GDP-weighted CLIF cycles	
Total financial flows				
A_t	-101***		-78.2***	
	(0.0015)		(8.6e-07)	
A_t^{fin}		-170**		-124***
		(0.022)		(0.0033)
A_t^{ind}		45.4		32.1
		(0.27)		(0.17)
CFE	Yes	Yes	Yes	Yes
TFE	No	No	No	No
Regressors	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.15	0.15	0.17	0.19
Log-likelihood	-56415	-56394	-56329	-56263
N	6882	6882	6882	6882
Portfolio flows				
A_t	-57.2**		-60.9***	
	(0.043)		(0.00015)	
A_t^{fin}		-117**		-93***
		(0.032)		(6.6e-06)
A_t^{ind}		42.2		21
		(0.11)		(0.23)
CFE	Yes	Yes	Yes	Yes
TFE	No	No	No	No
Regressors	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.035	0.04	0.067	0.082
Log-likelihood	-48170	-48155	-48069	-48018
N	6069	6069	6069	6069
Foreign direct investment				
A_t	0.0625		0.806	
	(0.99)		(0.88)	
A_t^{fin}		-27.2***		-8.92
		(0.0077)		(0.16)
A_t^{ind}		23.9***		9.09*
		(0.00027)		(0.064)
CFE	Yes	Yes	Yes	Yes
TFE	No	No	No	No
Regressors	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.068	0.071	0.068	0.07
Log-likelihood	-47752	-47741	-47752	-47744
N	6757	6757	6757	6757

Table A.7: Estimates of DGP 1 for semi-periphery countries for total financial flows, portfolio flows and FDIs

	Total investments		Portfolio		Short-term		FDI	
Estimations for DGP 1								
A_t×GDP	-48.4*		-74.6***		-13.8		11.6	
	(0.097)		(0.00015)		(0.43)		(0.16)	
A_t^{fin}×GDP		-114***		-46.6**		-59.2**		-2.14
		(2.5e-08)		(0.039)		(0.035)		(0.93)
A_t^{ind}×GDP		64.7**		-35.2*		46.3**		15.3
		(0.02)		(0.053)		(0.047)		(0.48)
CFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TFE	No	No	No	No	No	No	No	No
Regressors	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.22	0.24	0.1	0.1	0.1	0.11	0.022	0.023
Log-likelihood	-14776	-14755	-15219	-15219	-15301	-15297	-14478	-14478
N	1640	1640	1631	1631	1640	1640	1634	1634
Estimations for DGP 2								
A_t×GDP	-139***		-118***		-99.8***		52.3***	
	(0.0014)		(0.00085)		(1.8e-05)		(2.6e-09)	
$W_t^{trade}A_t$	424***		58.4		313**		54.3	
	(5.2e-05)		(0.43)		(0.029)		(0.33)	
$W_t^{geo}A_t$	-3.29		49		4.77		-26.6	
	(0.96)		(0.5)		(0.94)		(0.1)	
A_t^{fin}×GDP		-217***		-23.3		-143		9.17
		(0.0029)		(0.53)		(0.1)		(0.68)
A_t^{ind}×GDP		64.9		-109***		32.2		49.1*
		(0.13)		(0.0042)		(0.67)		(0.052)
$W_t^{trade}A_t^{fin}$		-101		238*		377		-551***
		(0.59)		(0.099)		(0.18)		(7.5e-09)
$W_t^{trade}A_t^{ind}$		356***		-41.4		35.2		331***
		(0.00023)		(0.31)		(0.84)		(5.4e-10)
$W_t^{geo}A_t^{fin}$		239***		-36		38		187***
		(0.0028)		(0.73)		(0.65)		(3.3e-06)
$W_t^{geo}A_t^{ind}$		-196***		66.4		-42.3		-159***
		(0.009)		(0.25)		(0.58)		(2.7e-06)
CFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regressors	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx	DeEcEx
R^2	0.15	0.17	0.086	0.088	0.056	0.061	0.03	0.043
Log-likelihood	-14629	-14608	-15113	-15112	-15165	-15161	-14394	-14383
N	1640	1640	1631	1631	1640	1640	1634	1634

Table A.8: Estimates of DGP 1 and 2 for smaller center countries and various financial flows

	Total investments		Portfolio		Short-term		FDI	
				Estimations for DGP 1				
$A_t \times$GDP	5.67		26.1		56.6		4.94	
	(0.74)		(0.26)		(0.14)		(0.59)	
$A_t^{fin} \times$GDP		-77.9		-25.8		-23.7		-7.26
		(0.22)		(0.25)		(0.76)		(0.36)
$A_t^{ind} \times$GDP		74.8		50.3**		79.6**		11.5
		(0.25)		(0.021)		(0.034)		(0.22)
CFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TFE	No	No	No	No	No	No	No	No
Regressors	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc
R^2	0.078	0.093	0.029	0.044	0.13	0.14	0.11	0.11
Log-likelihood	-17566	-17543	-9782	-9769	-17398	-17386	-11828	-11823
N	2774	2774	1683	1683	2771	2771	2390	2390
				Estimations for DGP 2				
$A_t \times$GDP	58.2		-56**		-56.4		-42.8**	
	(0.45)		(0.013)		(0.46)		(0.031)	
$W_t^{fin} A_t$	11.1		-2.23		-16.1**		2.18	
	(0.42)		(0.57)		(0.017)		(0.52)	
$W_t^{trade} A_t$	-50.1**		-20.4**		-28.1***		-4.8*	
	(0.033)		(0.033)		(0.006)		(0.059)	
$W_t^{cur} A_t$	102		24.1		101		-52.8***	
	(0.25)		(0.53)		(0.18)		(0.00065)	
$W_t^{geo} A_t$	0.152		196***		262***		123***	
	(1)		(2.4e-06)		(2e-05)		(2.7e-05)	
$A_t^{fin} \times$GDP		17.5		9.64		190*		-109**
		(0.9)		(0.86)		(0.07)		(0.03)
$A_t^{ind} \times$GDP		50.3		-74.8		-259***		63.2*
		(0.49)		(0.18)		(0.00025)		(0.072)
$W_t^{fin} A_t^{fin}$		7.15		11.1		12.4		-16.7***
		(0.41)		(0.43)		(0.15)		(0.00023)
$W_t^{fin} A_t^{ind}$		8.8		-5.6		-17.2**		13.2***
		(0.5)		(0.54)		(0.033)		(4.1e-06)
$W_t^{trade} A_t^{fin}$		15.3		-4.52		20		-8.22*
		(0.67)		(0.75)		(0.64)		(0.097)
$W_t^{trade} A_t^{ind}$		-33.6*		-9.36**		-20.8		3.17
		(0.091)		(0.033)		(0.19)		(0.24)
$W_t^{cur} A_t^{fin}$		-23.9		57.8		-33		38.8*
		(0.86)		(0.42)		(0.79)		(0.07)
$W_t^{cur} A_t^{ind}$		6.46		-30.6***		77.4		-94.9***
		(0.89)		(0.0093)		(0.1)		(7.5e-07)
$W_t^{geo} A_t^{fin}$		-249		-101***		-355*		182***
		(0.25)		(0.0064)		(0.066)		(0.0063)
$W_t^{geo} A_t^{ind}$		149		228***		473***		-19.5
		(0.18)		(3.2e-06)		(0.00045)		(0.51)
CFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regressors	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc	DeEc
R^2	0.091	0.12	0.094	0.11	0.16	0.19	0.21	0.27
Log-likelihood	-16501	-16464	-8923	-8905	-16380	-16334	-10960	-10857
N	2636	2636	1547	1547	2633	2633	2252	2252

Table A.9: Estimates of DGP 1 and 2 for periphery countries and various financial flows

Appendix B | Complements to Chapter 3

B.1 Classification of countries

This section provides details on the classification of countries for every period.

B.1.1 Introduction to the methodology

To classify countries according to the above categories, we rely on the data-driven classification procedure. The algorithm exploits 10 quantitative indicators, including GDP, demographic data, an education index, and the number of firms in the Global Fortune 500. The dataset contains 138 countries over the period 1975-2016. The separation between center, semi-periphery, and periphery countries is based on five measures: current GDP per capita, urbanization (as percentage of total population), percentage of population under 14, an education index, and a natural resource rent index.[1] The estimate of the leader-follower axis is based on five other measures: current and real GDP, number of firms in the Global Fortune 500, total urban population, and total population.[2]

The classification hinges on a statistically selected set of clustering algorithms which are used to propose groups of countries, called clusters, matching the theoretical categories. More specifically, seven clustering algorithms with six different numbers of clusters (from 8 to 13) for each algorithm have been used. The obtained clusters are subsequently

[1] The natural resource rent index is calculated by the World Bank "*as the difference between the price of a commodity and the average cost of producing it. This is done by estimating the price of units of specific commodities and subtracting estimates of average unit costs of extraction or harvesting costs. These unit rents are then multiplied by the physical quantities countries extract or harvest to determine the rents for each commodity as a share of gross domestic product (GDP)*" (data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS).

[2] The current GDP is provided by the World Bank and the real GDP by the Madison Project (which provides some very useful estimates for countries from the Eastern Bloc during the 1970s and 1980s).

classified as one of seven theoretical categories based on the theoretical model.[3] Every country in our sample is classified within 42 (7×6) different clusters, which are themselves associated with a theoretical category. A country is associated with the specific category to which it has been ranked the most times. In other words, a country is associated with a theoretical category based on the average of 42 different clustering sub-procedures.

Because the global economy is dynamic, we classified countries for three subperiods: 1970–90, 1990–2002, and 2002–16.[4] Our baseline classification includes countries that have stayed in the same category and exclude those that have moved from one category to another. For example, South Korea is excluded from our baseline sample because it is classified as a semi-periphery country for the first period and a center country for the third period. The graphs in this paper only exhibit results based on the baseline sample.[5] The group of center leader countries is made up of only five countries: the US, the UK, Japan, France, and Germany. These five countries are viewed as being at the root of the economic interdependencies (see below). China is the only world-leader semi-periphery country for the last period, but it is only a regional-leader semi-periphery country in the two preceding periods. Brazil, India, Mexico, and Russia are included in the regional-leader semi-periphery countries for all three periods. Twelve and 56 countries are classified as follower center and semi-periphery countries respectively. [6]

B.1.2 Estimations

Tables B.1 and B.2, and Figures B-1, B-2 and B-3 show the results of the classification that were used in this study.

[3]These categories are world-leader center, regional-leader center, follower center, world-leader semi-periphery, regional-leader semi-periphery, and periphery countries.

[4]These periods are the same as those used in Subsection 3.3.

[5]Other results can be obtained upon request.

[6]We can also note that alternative samples have been tested. All our results have been consistent with our below-explained theoretical framework and empirical observations. These estimates are available upon request.

	Center	Semi-periphery	Periphery
World Leader	US	China (only for the last period)	/
Regional Leader	France, UK, Japan, Germany	Brazil, India, Mexico, Russia	/
Follower	Australia, Austria, Belgium, Canada, Switzerland, Denmark, Finland, Iceland, Luxembourg, Netherlands, Norway, Sweden	Albania, Argentina, Armenia, Azerbaijan, Bulgaria, Bahrain, Belarus, Bolivia, Chile, Congo (Brazzaville), Colombia, Costa Rica, Cyprus, Czech Rep., Djibouti, Dominican Rep., Ecuador, Gabon, Georgia, Greece, Iraq, Israel, Jamaica, Jordan, Kazakhstan, Kyrgyzstan, Kuwait, Lebanon, Libya, North Macedonia, Malta, Mongolia, Mauritius, Malaysia, Nicaragua, Oman, Panama, Peru, Philippines, Poland, Portugal, Paraguay, Qatar, Romania, Saudi Arabia, El Salvador, Slovakia, Thailand, Trinidad and Tobago, Tunisia, Turkey, Ukraine, Uruguay, Uzbekistan, Venezuela, South Africa	Burundi, Benin, Burkina Faso, Bangladesh, Central African Republic, Cote d'Ivoire, Cameroon, RDC, Egypt, Ethiopia, Ghana, Guinea, Gambia, Guinea-Bissau, Guatemala, Honduras, Haiti, Kenya, Laos, Lesotho, Madagascar, Mali, Mozambique, Mauritania, Malawi, Namibia, Niger, Nigeria, Nepal, Pakistan, Rwanda, Sudan, Senegal, Sierra Leone, Swaziland, Syria, Chad, Togo, Tanzania, Uganda, Yemen, Zambia, Zimbabwe

Table B.1: Classification of countries - 1975-2016

Names	P1	P2	P3	All	Fin. flows	Names	P1	P2	P3	All	Fin. flows
Afghanistan	P-F	N	P-F	X	2008	Angola	P-F	S-F	S-F	X	2012
Albania	S-F	S-F	S-F	S-F	1995	United Arab Emirates	N	S-F	S-F	X	no data
Argentina	S-F	S-F	S-F	S-F	1976	**Armenia**	S-F	S-F	S-F	S-F	1993
Australia	C-F	C-F	C-F	C-F	1989	Austria	C-F	C-F	C-F	C-F	2005
Azerbaijan	S-F	S-F	S-F	S-F	1999	Burundi	P-F	P-F	P-F	P-F	no data
Belgium	C-F	C-F	C-F	C-F	2002	Benin	P-F	P-F	P-F	P-F	no data
Burkina Faso	P-F	P-F	P-F	P-F	no data	Bangladesh	P-F	P-F	P-F	P-F	1976
Bulgaria	S-F	S-F	S-F	S-F	1991	**Bahrain**	S-F	S-F	S-F	S-F	2011*
Belarus	S-F	S-F	S-F	S-F	1996	**Bolivia**	S-F	S-F	S-F	S-F	1977
Brazil	S-RL	S-RL	S-RL	S-RL	1975	Botswana	P-F	S-F	S-F	X	no data
Central African Rep.	P-F	P-F	P-F	P-F	no data	Canada	C-F	C-F	C-F	C-F	1970
Switzerland	C-F	C-F	C-F	C-F	1999	**Chile**	S-F	S-F	S-F	S-F	1991
China	S-RL	S-RL	S-WL	X	2005	Cote d'Ivoire	P-F	P-F	P-F	P-F	no data
Cameroon	P-F	P-F	P-F	P-F	1979**	RDC	P-F	P-F	P-F	P-F	no data
Rep. of Congo	S-F	S-F	S-F	S-F	1981**	**Colombia**	S-F	S-F	S-F	S-F	1996
Costa Rica	S-F	S-F	S-F	S-F	1999	**Cyprus**	S-F	S-F	S-F	S-F	2001
Czech Republic	S-F	S-F	S-F	S-F	1993	Germany	C-RL	C-RL	C-RL	C-RL	1971
Djibouti	S-F	S-F	S-F	S-F	no data	Denmark	C-F	C-F	C-F	C-F	1975
Dominican Rep.	S-F	S-F	S-F	S-F	2011	Algeria	P-F	S-F	S-F	X	2014
Ecuador	S-F	S-F	S-F	S-F	1993	Egypt	P-F	P-F	P-F	P-F	2011
Spain	S-F	S-F	C-F	X	1975	Estonia	X	S-F	S-F	X	1992
Ethiopia	P-F	P-F	P-F	P-F	1977**	Finland	C-F	C-F	C-F	C-F	1975
France	C-RL	C-RL	C-RL	C-RL	1975	**Gabon**	S-F	S-F	S-F	S-F	1978
United Kingdom	C-RL	C-RL	C-RL	C-RL	1970	**Georgia**	S-F	S-F	S-F	S-F	1997
Ghana	P-F	P-F	P-F	P-F	2011	Guinea	P-F	P-F	P-F	P-F	2011
Gambia	P-F	P-F	P-F	P-F	2007	Guinea-Bissau	P-F	P-F	P-F	P-F	no data
Equatorial Guinea	P-F	S-F	S-F	X	no data	**Greece**	S-F	S-F	S-F	S-F	1976**
Guatemala	P-F	P-F	P-F	P-F	1977	Honduras	P-F	P-F	P-F	P-F	2004
Croatia	N	S-F	S-F	X	1993	Haiti	P-F	P-F	P-F	P-F	2004
Hungary	N	S-F	S-F	X	1989	Indonesia	P-F	S-RL	S-RL	X	1981
India	S-RL	S-RL	S-RL	S-RL	1975	**Ireland**	S-F	S-F	C-F	X	2005
Isl. Rep. of Iran	P-F	S-F	S-F	X	no data	**Iraq**	S-F	S-F	S-F	S-F	2013
Iceland	C-F	C-F	C-F	C-F	1976	**Israel**	S-F	S-F	S-F	S-F	1972
Italy	C-RL	C-RL	C-F	X	1970	**Jamaica**	S-F	S-F	S-F	S-F	2012
Jordan	S-F	S-F	S-F	S-F	1977	Japan	C-RL	C-RL	C-RL	C-RL	1996
Kazakhstan	S-F	S-F	S-F	S-F	1995	Kenya	P-F	P-F	P-F	P-F	no data
Kyrgyzstan	S-F	S-F	S-F	S-F	1993	Cambodia	N	P-F	P-F	X	1994
Korea, Rep. of	S-F	S-F	C-F	X	1976	**Kuwait**	S-F	S-F	S-F	S-F	2015
Laos	P-F	P-F	P-F	P-F	1994**	**Lebanon**	S-F	S-F	S-F	S-F	2002
Liberia	X	P-F	P-F	X	2010	**Libya**	S-F	S-F	S-F	S-F	no data
Sri Lanka	P-F	S-F	P-F	X	1977	Lesotho	P-F	P-F	P-F	P-F	1982
Lithuania	N	S-F	S-F	X	1993	Luxembourg	C-F	C-F	C-F	C-F	2002

Latvia	N	S-F	S-F	X	1993	Morocco	P-F	S-F	S-F	X	2003
Moldova	N	S-F	S-F	X	1994	Madagascar	P-F	P-F	P-F	P-F	2003
Mexico	S-RL	S-RL	S-RL	S-RL	1979	**Macedonia**	S-F	S-F	S-F	S-F	1996
Mali	P-F	P-F	P-F	P-F	no data	**Malta**	S-F	S-F	S-F	S-F	1995
Myanmar	N	P-F	P-F	X	1976	**Mongolia**	S-F	S-F	S-F	S-F	1998
Mozambique	P-F	P-F	P-F	P-F	2005	Mauritania	P-F	P-F	P-F	P-F	2012
Mauritius	S-F	S-F	S-F	S-F	2000	Malawi	P-F	P-F	P-F	P-F	1999
Malaysia	S-F	S-F	S-F	S-F	1999	Namibia	P-F	P-F	P-F	P-F	1999
Niger	P-F	P-F	P-F	P-F	no data	Nigeria	P-F	P-F	P-F	P-F	1990**
Nicaragua	S-F	S-F	S-F	S-F	1992	Netherlands	C-F	C-F	C-F	C-F	1970
Norway	C-F	C-F	C-F	C-F	1975**	Nepal	P-F	P-F	P-F	P-F	1977
New Zealand	C-F	S-F	C-F	X	2000	**Oman**	S-F	S-F	S-F	S-F	no data
Pakistan	P-F	P-F	P-F	P-F	1976	**Panama**	S-F	S-F	S-F	S-F	1998
Peru	S-F	S-F	S-F	S-F	1977**	**Philippines**	S-F	S-F	S-F	S-F	1977
Poland	S-F	S-F	S-F	S-F	2000	**Portugal**	S-F	S-F	S-F	S-F	1975
Paraguay	S-F	S-F	S-F	S-F	1977**	**Qatar**	S-F	S-F	S-F	S-F	2011
Romania	S-F	S-F	S-F	S-F	1991	**Russian Fed.**	S-RL	S-RL	S-RL	S-RL	1994
Rwanda	P-F	P-F	P-F	P-F	no data	**Saudi Arabia**	S-F	S-F	S-F	S-F	2006
Sudan	P-F	P-F	P-F	P-F	1977	Senegal	P-F	P-F	P-F	P-F	1995
Singapore	S-F	S-F	C-F	X	1995	Sierra Leone	P-F	P-F	P-F	P-F	no data
El Salvador	S-F	S-F	S-F	S-F	1999	Serbia	N	S-F	S-F	X	2007
Slovakia	S-F	S-F	S-F	S-F	1993	Slovenia	N	S-F	S-F	X	1992
Sweden	C-F	C-F	C-F	C-F	1975	Swaziland	P-F	P-F	P-F	P-F	2011
Syria	P-F	P-F	P-F	P-F	no data	Chad	P-F	P-F	P-F	P-F	no data
Togo	P-F	P-F	P-F	P-F	no data	**Thailand**	S-F	S-F	S-F	S-F	1976
Tajikistan	S-F	P-F	P-F	X	2002	**Trinidad and Tobago**	S-F	S-F	S-F	S-F	2015
Tunisia	S-F	S-F	S-F	S-F	no data	**Turkey**	S-F	S-F	S-F	S-F	1984
Tanzania	P-F	P-F	P-F	P-F	2012	Uganda	P-F	P-F	P-F	P-F	1980**
Ukraine	S-F	S-F	S-F	S-F	1994	**Uruguay**	S-F	S-F	S-F	S-F	2000
United States	C-WL	C-WL	C-WL	C-WL	1973	**Uzbekistan**	S-F	S-F	S-F	S-F	2014
Venezuela	S-F	S-F	S-F	S-F	1994	Viet Nam	P-F	P-F	P-F	S-F	1996
Yemen	P-F	P-F	P-F	P-F	2005	**South Africa**	S-F	S-F	S-F	S-F	1970
Zambia	P-F	P-F	P-F	P-F	2005	Zimbabwe	P-F	P-F	P-F	P-F	2017

Table B.2: Classification details and IMF financial flow data

* only for mentioned year ** with at least one break in the data

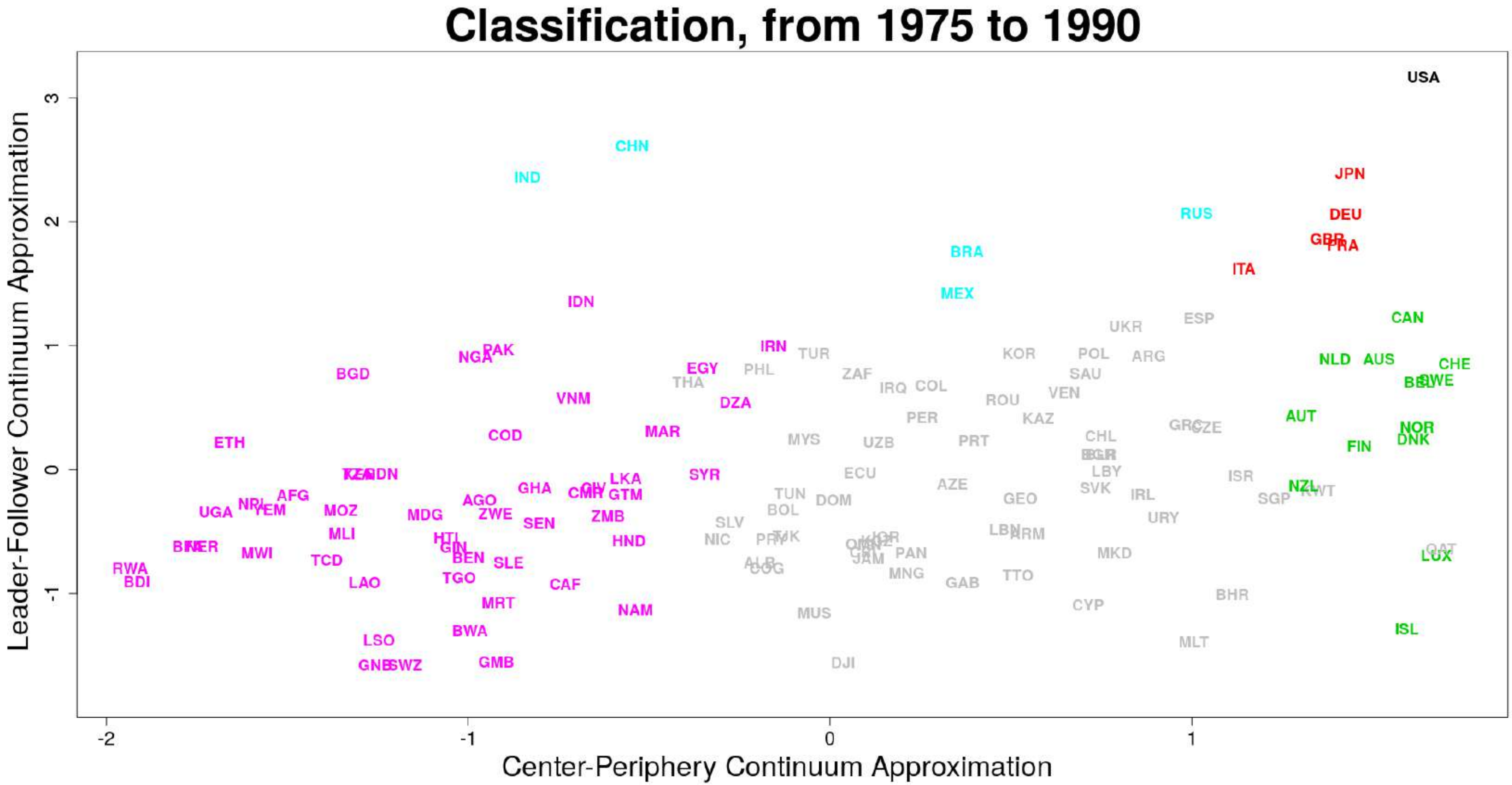

Figure B-1: Result of the classification procedure, first period

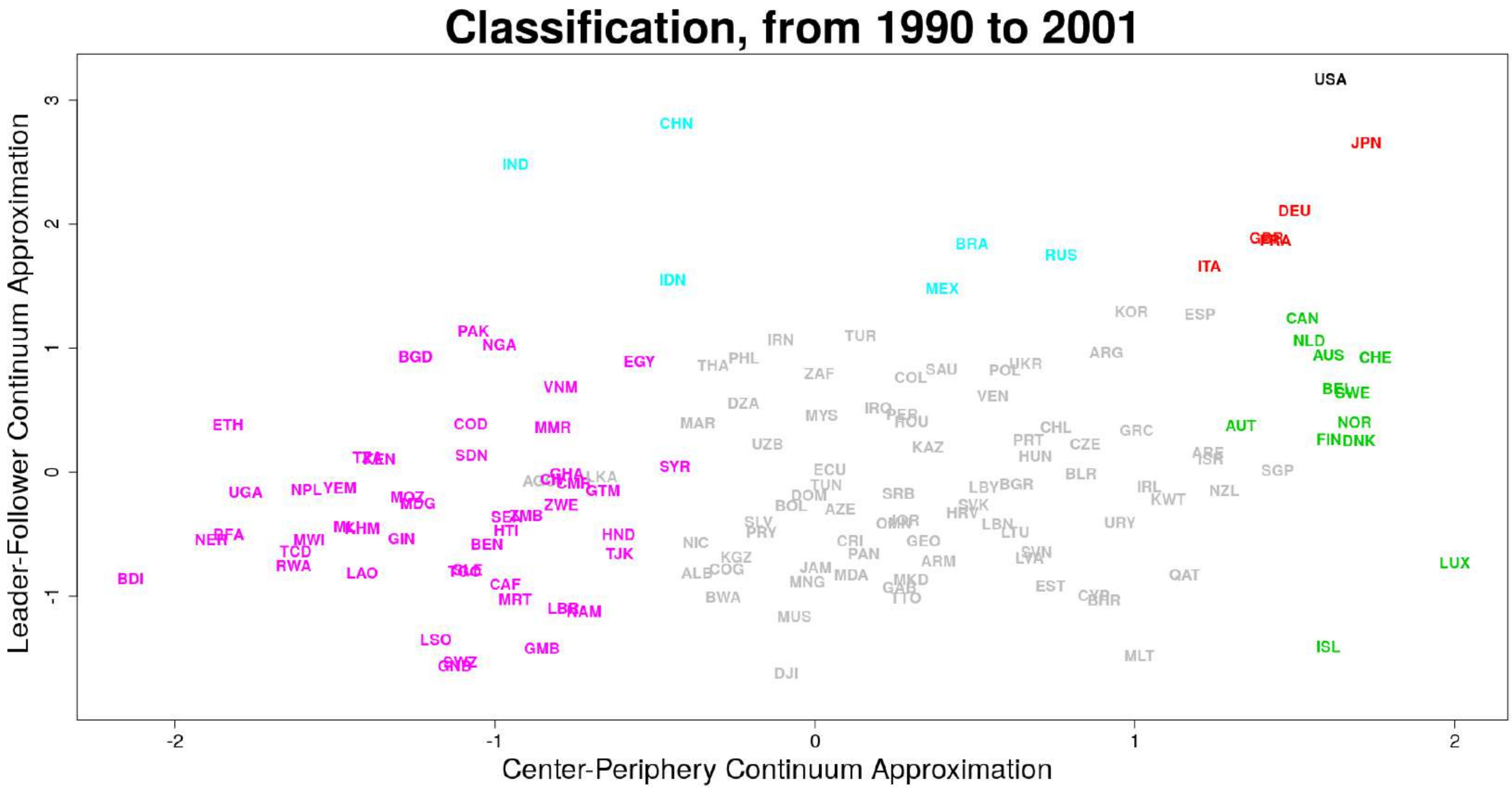

Figure B-2: Result of the classification procedure, second period

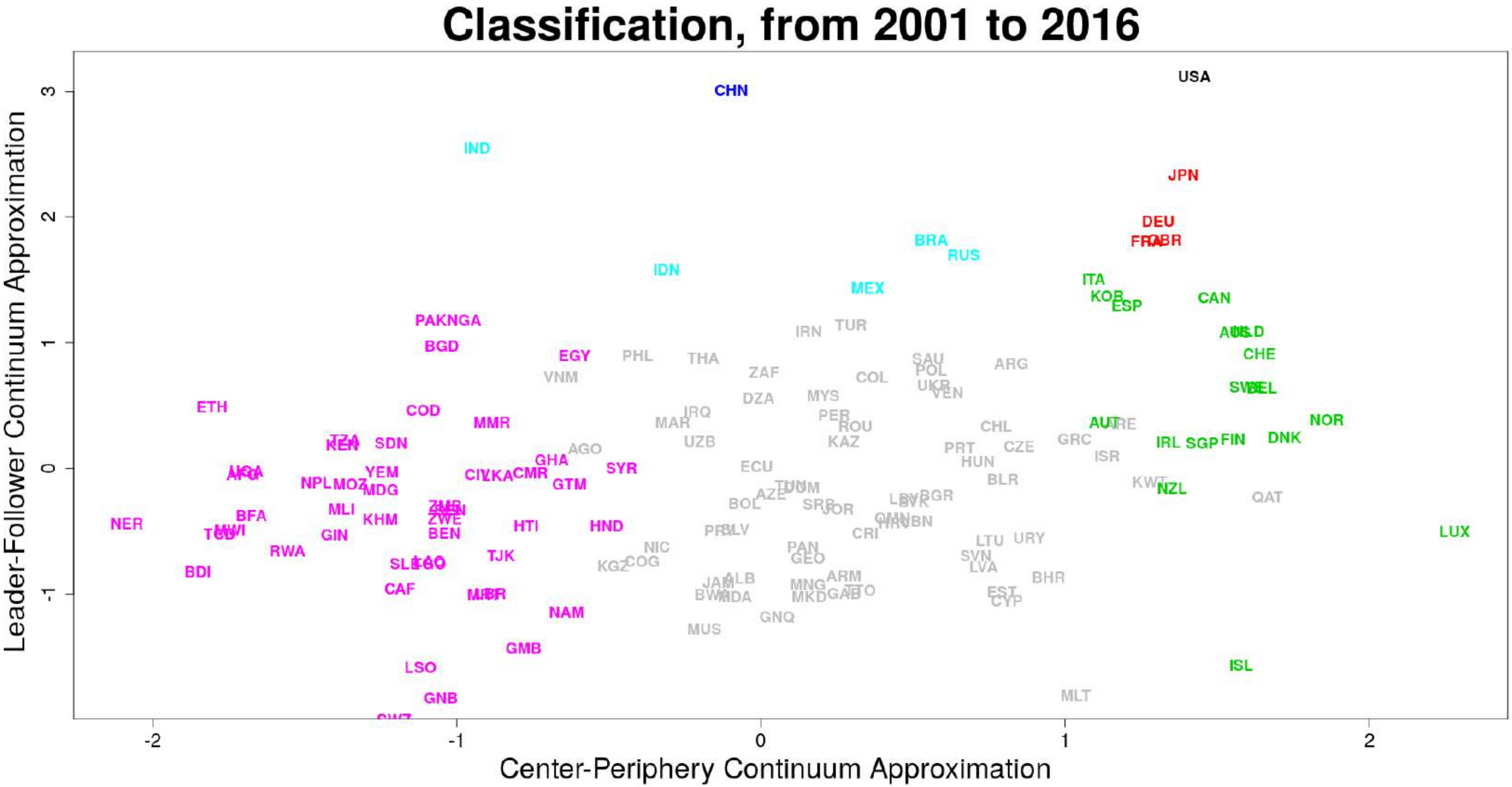

Figure B-3: Result of the classification procedure, third period

B.2 Geography: push and pull factors

This section explains why investors allocate their funds to semi-periphery countries and where inside the semi-periphery.

The industrial roots of investment flows to the semi-periphery

The main idea of the model is that investors have to decide where to allocate their funds. The set of all investment strategies can be segmented in two groups. Investments can be made in (a) center countries or in (b) semi-periphery countries. In every period of time, investors have to decide the amount of money to allocate in each group (as well as the nature of the financial products in each group).

Two categories of investments can be distinguished due to their distinct macroeconomic implications.[7] Firstly, investments in productive capacities, or productive investments, are investments made to establish or reinforce nonfinancial business operations (e.g., by generating more production capacity, greenfield investments) or to acquire control of an existing company (M&A). They primarily take the form of FDIs. Secondly, financial investments are composed of portfolio investments, loans, or derivative investments made for financial purposes (diversifying risk, obtaining higher short-term returns, etc.).

The choice of location for international investments in productive capacities depends on several industrial determinants and pull and push factors (see below). Regarding FDI flows, our analysis relies on Dunning's eclectic paradigm and its ownership, location, and internalization (OLI) configuration and on Berhmann's FDI taxonomy (Dunning and Lundan, 2008). In this framework, productive investments by MNEs of the center to the semi-periphery correspond to efficiency-seeking, resource-seeking, market-seeking and/or strategic asset-seeking investments.

As mentioned in Section 1.2.3, semi-periphery countries have many location-specific

[7] For the sake of simplicity, we only consider "final destination" investments and do not include "intermediate" investments. For example, we leave out MNEs' use of special purpose entities (SPEs) to channel investments through several countries before reaching their final destinations for the purpose of reducing tax and regulatory obligations.

advantages that can attract productive investments. These industrial determinants define the long-term characteristics of host countries that can attract financial flows.[8] They notably consist of: low average production cost – including relative wage differences and unit labor costs (Holland and Pain, 1998; Bevan and Estrin, 2004) – ; a surplus of underemployed, low-paid and sufficiently skilled workers (Zhang and Markusen, 1999) as well as a pool of highly qualified labor; large domestic market size (Wheeler and Mody, 1992; Zhang and Markusen, 1999); adequate energy and transport infrastructure; the existence of Marshallian industrial districts (Wheeler and Mody, 1992);[9] relative natural resource endowment and availability;[10] and geographical proximity to center economies and low transport costs (Brainard, 1997). In the model, we assume that these crucial industrial determinants are modeled by the position of the country inside the center-periphery and leader-follower continuums.

Industrial determinants are key to understanding international financial flows. Through the development of their IPNs since the 1960s, MNEs have developed massive waves of FDI that have played the driving role in the globalization of productive investments and had a major impact on international financial flows (Aglietta, 2000; Lanz and Miroudot, 2011a; Bonturi and Fukasaku, 1993; Fukasaku and Kimura, 2002). A large share of (final destination) investment flows from the center to the semi-periphery are productive investments. Furthermore, even if many additional financial factors can lead investors of center countries to invest in semi-periphery countries,[11] a large share of financial investments are conditional upon the existence of sufficient prior productive investments, namely sufficient

[8]See Jain et al. (2016) for a recent and complete overview.

[9]They are defined as areas with large external economies of scale. For example, they include the Pearl River Delta Economic Zone in China, Sinos Valley for shoes production in Brazil, Bangalore in India for IT services, aeronautics and electronics, Gumi (North Gyeongsang) in South Korea, Plzeň (Pilsen) in the Czech Republic, the SIJORI Growth Triangle (a partnership arrangement between Singapore, Johor in Malaysia, and Riau Islands in Indonesia), Ciudad Juárez and Tijuana in Mexico, Tangier in northwestern Morocco, Istanbul and the Eastern Marmara Region in Turkey, as well as the Pretoria Witwatersrand Vereeniging (PWV) region in South Africa.

[10]Natural resources have complex effect on FDI (see Asiedu, 2013; Jain et al., 2016; Mina, 2007).

[11]We can mention two examples. Diversification plans of banks in center countries in Europe were born from the need for higher returns in traditional banking activities in the period of low growth in the area in 1990s. Large interest rate differentials can also be a reason for the attractiveness of some semi-periphery countries. This leads to carry trade strategies after the Japanese bubble burst in 1990s or after the GFC.

infrastructures and macroeconomic characteristics.[12] Consequently, financial investments are viewed as conditional upon industrial determinants, meaning the distinctions between center, semi-periphery, and periphery as well as between leaders and followers.

Pull and push factors

These factors are the economic and political changes which respectively either forcefully attract international financial flows into the area (pull) or repel capital so that it flows out of the area (push). They are viewed as disruptive and having localized geographical and temporal origins. While most pull and push factors are created by economic trends (e.g., economic growth, a decrease in trade balance, industrialization process, etc.), their occurrence and shape are difficult to anticipate (e.g., the date and impact of political unrest, the magnitude of a disruptive change in monetary policy, etc.).

We either take the perspective of a specific semi-periphery country or of all semi-periphery countries as a set to define domestic and international factors:

Domestic pull and push factors Domestic pull (resp. push) factors are those that attract (resp. repel or stem) financial flows to a specific semi-periphery country. This economic phenomenon can find its origins in center or semi-periphery economies. Major pull and push factors can take different shapes, but most are well-known phenomena. In order to give more intuition about these factors, some examples can be given.[13] Dominant domestic pull factors include: the adoption of pro-market economic reforms (e.g., SAPs, business liberalization policies, etc.); (an expectation of) an accession to a regional trade agreement that includes center economies (e.g., the EU or NAFTA); a major privatization policy of SOEs (e.g., through debt equity swaps); a past currency depreciation; and (an expectation of) an abrupt currency appreciation; as well as (an expectation of) an increase in competitiveness; and a domestic policy that increases

[12] This is the case even for offshore and financial hubs. For example, Hong Kong and Singapore were commercial and industrial ports. The creation of financial hubs is usually the product of a certain amount of prior industrial investment.

[13] See Appendix B.2 for additional elements of these concepts and a list of what we refer to domestic and international pull and push factors as well as some of their interactions with some financial crises.

financial openness. Fundamental domestic push factors are massive political instability, (an anticipation of) an abrupt currency devaluation, and an (expectation of) abrupt rise in capital levy.

International pull and push factors In contrast, international pull (resp. push) factors are those that increase the net capital inflow (resp. outflow) of several semi-periphery economies (almost exclusively caused by or through changes in the economies of the center). Notable examples of such international pull factors are: the publication of a glowing report by an international organization (e.g., the 1993 Work Bank report on the "East Asian Miracle"), a favorable financial international policy of center economies (e.g., the Baker and Brady plans), and a decrease in interest rates in the center economies (e.g., for carry trade strategies). Major international push factors include an abrupt change in commodity prices (e.g., the oil shocks of the 1970s and 1980s, the slowdown of the international demand in 2010s) and a contagion effect, namely foreign investors' loss of confidence in an economic area due to the collapse of the geographically close country (e.g., the Tequila or Latino Effect in the mid-1990s).

For the sake of simplicity, we focus on a subset of major pull and push factors, assuming that they are the most crucial (see Hypothesis 3.1). See Tables B.3 and B.4 for a list of what we refer to domestic and international pull and push factors as well as some of their interactions with some financial crises.

Three important characteristics of pull and push factors can be highlighted. Firstly, some major factors are "one-shot" factors: they cannot, or are very unlikely to, happen more than once. This is the case with large privatization processes, some key integration processes, and large financial openness. The most emblematic example is the collapse of the USSR and the integration of the Eastern Bloc into global capitalism. Secondly, we assume that the overall macroeconomic effects of pull and push factors on the semi-periphery are not in large part procyclical relative CLIF cycles. This implies that the idiosyncratic components of pull (resp. push) factors do not massively increase (resp.

decrease) the attractiveness of the semi-periphery during the upward (resp. downward) phase of the CLIF cycles. In other words, this means that the terms P_t^s and $\bar{P}_t^s$ in Equation 3.1 do not turn to be significantly procyclical with A_t^c due to idiosyncratic events so that it blurs or compensates the average effects of the other majors affected the net outward ratio, as highlighted by Equation 3.2.[14] Thirdly, pull and push factors have to be distinguished from industrial determinants.

The three main intertwined differences between industrial determinants and pull and push factors are the following: (i) industrial determinants primarily reflect the position of countries in the center-periphery and leader-follower continuums; (ii) industrial determinants are long-term characteristics of countries , while pull and push factors can be changed in the short-term; (iii) push and pull factors are the consequences of decisions made by governments, development and central banks, international organizations, and/or populations.

[14]Remind that Hypothesis 3.4 enables us to define a function f such that the net outward ratio ${}^{no}\rho_t^c$ can be approximated in Equation 3.1 which is equivalent to:

$$ {}^{no}\rho_t^c \approx f\left(\frac{R_t^s}{R_t^c};\frac{\sigma_t^s}{\sigma_t^c};\frac{l_t^s}{l_t^c};\frac{MP_t^s}{MP_t^c};P_t^s;\bar{P}_t^s\right) \approx f\left(\frac{R_t^s}{R_t^c};\frac{\sigma_t^s}{\sigma_t^c};\frac{l_t^s}{l_t^c};\frac{MP_t^s}{MP_t^c};P^s(A_t^c);\bar{P}^s(A_t^c)\right) + \mathcal{I}(P_t^s;\bar{P}_t^s), $$

with the second term in the right side of the equation representing idiosyncratic components of the pull and push factors unrelated to the CLIF cycles and $P^s(A_t^c)$ and $\bar{P}^s(A_t^c)$ reflecting the component of these pull and push factors that are caused by these medium-term cycles. Based on this decomposition, we can formulate Equation 3.2:

$$ \begin{aligned} \frac{\partial\, {}^{no}\rho_t^c}{\partial A_t^c} \approx\ & \underbrace{\frac{\partial f}{\partial R_t^s/R_t^c}}_{>0} \times \underbrace{\frac{\partial R_t^s/R_t^c}{\partial A_t^c}}_{<0} + \underbrace{\frac{\partial f}{\partial \sigma_t^s/\sigma_t^c}}_{<0} \times \underbrace{\frac{\partial \sigma_t^s/\sigma_t^c}{\partial A_t^c}}_{>0} + \underbrace{\frac{\partial f}{\partial l_t^s/l_t^c}}_{>0} \times \underbrace{\frac{\partial l_t^s/l_t^c}{\partial A_t^c}}_{<0} \\ & + \underbrace{\frac{\partial f}{\partial MP_t^s/MP_t^c}}_{<0} \times \underbrace{\frac{\partial MP_t^s/MP_t^c}{\partial A_t^c}}_{>0} + \underbrace{\frac{\partial f}{\partial P_t^s}}_{>0} \times \underbrace{\frac{\partial P_t^s}{\partial A_t^c}}_{<0} + \underbrace{\frac{\partial f}{\partial \bar{P}_t^s}}_{<0} \times \underbrace{\frac{\partial \bar{P}_t^s}{\partial A_t^c}}_{>0} < 0, \end{aligned} $$

This relation is used to indicate that the decomposition of the net outward ratio ${}^{no}\rho_t^c$ in its different major components suggest that the net outward ratio is countercyclical to the CLIF cycles. In this equation, the signs for $\bar{P}_t^s$ and P_t^s reflect an average tendency.

	Names	Definitions	Examples	References
	Increasing the insertion of the national economy into IPNs			
domestic	SAP	the adoptions of Structural Adjustment Programs	Mexico late 1980s, Eastern Europe 1990s	Campos and Kinoshita (2008); Bulmer-Thomas (2003); Collier and Gunning (1999)
domestic	Creation of special economic zone	the tax breaks, the creations of free-trade zones and export-processing zones with specific tax and labor law rules	Ireland in 1958, Singapore in 1968	Murphy 2016, Lane 2016
domestic	pro-business reforms	include the enactment of domestic laws or highly visible commitments by local government that protect IPR and FDI, the improvements in the protection of intellectual rights	Mexico in the 1990s, Ireland in the 1970s and 1980s, Eastern Europe in the 1990s	Campos and Kinoshita (2008)
domestic	trade agreement	(anticipation of) the conclusion of an important multilateral or bilateral trade agreement that provides a better access to important markets of the center that stimulate the creation of export platform or outsourcing	EU memberships of eastern European countries, 1996 agreement between Turkey with the EU, NAFTA, the EPAs and FTAs between some Pacific Asian economies and Japan, the US and the EU	Bevan and Estrin (2004)
domestic	accession to the WTO	the accession to the General Agreement on Tariffs and Trade (GATT) or WTO is a significant institutional change that strengthen the resilience of IPNs	Mexico in 1985, Eastern Europe in the 1990s or China in 2001	
domestic	investment in infrastructure	large and recent investments and improvements in communication and transport infrastructures	Thailand late 1980s early 1990s	Yamamura and Hatch 1997
domestic	privatization	large privatization policies of SOEs (e.g, debt equity swaps)	Latin America and Eastern Europe in the 1990s	Carstensen and Toubal (2004); Bulmer-Thomas (2003); Campos and Kinoshita (2008)
domestic	new financial market	the creation of new financial markets (often opening of stock markets in formerly state-controlled economies)	Thailand, Russia, Latin America in the 1990s	
domestic	financial openness	financial openness: The two most important measures are those aiming to relax capital control and those allowing the establishment of foreign financial institutions	Mexico and Brazil in 1997 financial reforms	
domestic	integrative Monetary policies	adoption of specific monetary policies such as pegging, the establishment of currency board or the dollarization of the economy	Argentina's Currency Board from 1991 to 2002	
	Other domestic factors			
domestic	recent devaluation	the recent past currency depreciation or devaluation and the subsequent (anticipation of) abrupt currency appreciation as well as the potential competitiveness gain	/	
domestic	financial hype	emergence of very attractive financial products in the semi-periphery that became known investors as safe and profitable and lead to sudden and strong rise in popularity	the Mexican Tesobonos in the early 1990s	Calvo 2008
international	favorable official publications	the publication of favorable reports that express the endorsement by major international institutions, think-tanks or consultancy companies and that contribute to the international valorization of the economy and crystalizing the financial hype to some places	the 1993 Work Bank report on the "East Asian Miracle", reports from the IMF, EU and the European Bank for Reconstruction and Development (EBRD) on the economic transition of the Visegrád group economies	Aliber and Kindleberger (2017)
international	external financial aids	financial policies of center economies that alleviate the debt burden of one or some periphery economies	Baker plan, Brady plan, Japan ODA in ASEAN economies in the late 1980s, EU Pre-accession aid to Eastern Europe	
international	expansionary monetary policies	the decrease in interest rates in center economies (e.g., for carry trade strategies)	Japan (starting in the 1990s)	
international	price boom	international economic blossoming of domestic specializations (e.g., large oil resources in periods of oil price boom)		
international	geopolitical changes	geopolitical changes reshaping IPNs, efficiency-seeking and strateic asset-seeking FDIs	collapse of the Warsaw Pact; South Korea and Taiwan were inserted in US and Japanese IPNs notably thanks to their close geopolitical ties with the US that provided with important aid funds and preferential access to the US markets; the increasing rivalry between China and the US	Defraigne and Nouveau (2021)

Table B.3: Pull factors: definitions, examples and references

	Names	Definitions	Examples	References
domestic	political and social unrest	emergence of disruptive political and social movements contesting the running government	Mexico 1994	Krugman 2001
domestic	anti-western political shift			Krugman 2001
domestic	new financial assessment	new financial report of the state of the economy	Greece 2009, Russia 1998, Thailand 1996, Mexico 1994	
domestic	forthcoming devaluation	(anticipation of) abrupt currency devaluation or depreciation	China 2012-2016, Latin America in the early 1990s and in the late 1990s, after 2015	Kroeber 2020, Ravenhill 2015
domestic	increase in taxation	(anticipation of) abrupt taxation changes in order to resolve the government's burdening debt	Greece 2015	
domestic	capital flight or financial stress	large capital flight or financial stress and (anticipation of) the subsequent chaotic macroeconomic conditions generated by the debt crisis that included drastic devaluation, hyperinflation, austerity measures, GDP contractions and social instability (even to wars in some countries)	Greece in the 2000s, Lebanon 2019, Russia 1998 and 2014-2020, Argentina 1999-2001, Mexico 1981-1982	(Lustig, 2000) Krugman 2001,
international	international liquidity shortage	sharp decrease in international liquidity due to a brutal tight and stringent monetary policy or a credit crunch resulting from the burst of a financial bubble in center economies	1979-81 Volcker's shock, 2007-09 Global Financial Crisis	
international	drop in commodity prices	abrupt decrease in commodity prices due to the demand of center economies	1981-1984, 2012-2016, 2020	
international	contagion effect	abrupt loss of confidence of foreign investors relative to some semi-periphery countries due to the emergence of a push factor in another semi-periphery countries geographically close	Latin America (tequila crisis) in 1994-5, South East Asia in 1996-8, Eurozone 2009-12	Uribe et al. (1996); Calvo and Talvi (2008)

Table B.4: Push factors: definitions, examples and references

B.3 Complements to the volume and substitution effects

This subsection explains the reasons for the countercyclical nature of investment from center to semi-periphery countries relative to the CLIF cycles. It also argues that these medium-term cycles in the center can be regarded as major factors triggering financial crises in the semi-periphery.

B.3.1 Volume and substitution effects

In order to illustrate some key theoretical arguments and to provide testable propositions, we present a simple formal model. It includes two economic areas: the center and the semi-periphery (excluding China), whose associated variables are respectively indicated with the exponents c and s. All variables are expressed in real values.

We define I_t^c and I_t^s as the amounts of money invested respectively at a given point in time t in center and semi-periphery countries. The capital stock and savings in center economies are respectively K_t^c and S_t^c. The net amount of financial flows invested from the center to the semi-periphery is denoted by ${}^n\Phi_t^{c,s}$.[15] Because the aim is to highlight the cyclical dynamics of financial flows between the center and the semi-periphery, variables relative to investments, capital stocks, and flows are divided by the long-term trend of the global GDP, written $\tilde{Y}_t$. Global investment, financial flows, capital stocks, and savings are respectively $i_t^* = I_t^*/\tilde{Y}_t$, ${}^n\phi_t^{*1*2} = {}^n\Phi_t^{*1*2}/\tilde{Y}_t$, $k_t^* = K_t^*/\tilde{Y}_t$ and $s_t^* = S_t^*/\tilde{Y}_t$ with $*$ being c or s.[16] We note A_t^c the medium-term CLIF cycles (see Subsection 1.2.4 for theoretical details and Section 2.2.3 for empirical estimations).[17] If A_t^c is negative, it means that

[15]It can be recalled that in an open economy the investment equals the sum between the domestic savings and the net capital inflows: $I_t^s = S_t^s -^n \Phi_t^{c,s} = S_t^s - NX_t^s$, where NX_t^s is net exports, or the net capital outflows, of semi-periphery countries.

[16]The trend is regarded as the smoothed value of the GDP: $\tilde{Y}_t = f_s(Y_t)$ where f_s is a smoothing function. This is in order to take into account the effect of the fluctuation of the GDP along the CLIF cycles. Variables are assumed to be perfectly trend-corrected and only represent medium-term fluctuations.

[17]As shown previously, the dynamic of A_t^c is considered as endogenous and internal to center economies

center economies, as a whole, are experiencing the downward phase of the CLIF cycles in time t.

Following Hypothesis 3.2, we assume that ${}^{n}\phi_t^{c,s} = -{}^{n}\phi_t^{s,c}$ (we neglect other economies).[18] The net amount of foreign investments ${}^{n}\phi_t^{c,s}$ can be decomposed in two components: ${}^{n}\phi_t^{c,s} = {}^{no}\phi_t^{c} - {}^{no}\phi_t^{s} = {}^{ni}\phi_t^{s} - {}^{ni}\phi_t^{c}$ where ${}^{no}\phi_t^{c}$ (resp. ${}^{ni}\phi_t^{c}$) is the net outward (resp. inward) investments of center countries, and similarly for semi-periphery countries. A schematic of the flows is exhibited in Figure B-4. Investment in semi-periphery economies is then given by $i_t^s = s_t^s - {}^{no}\phi_t^s + {}^{no}\phi_t^c$. The net outward investment flow of center countries is itself made up of two subcategories: ${}^{no}\phi_t^c = {}^{a}\phi_t^c - {}^{r}\phi_t^c$ where ${}^{a}\phi_t^c \geq 0$ represents new acquisitions by center economies' investors of semi-periphery economies' financial assets and ${}^{r}\phi_t^c \geq 0$ indicates the amount of financial assets that are sold (returned) by center economies' investors to semipheriphery economies' investors. Based on the same logic, we can write the following decomposition:

$$ {}^{n}\phi_t^{c,s} = \underbrace{\left({}^{a}\phi_t^c - {}^{r}\phi_t^c\right)}_{={}^{no}\phi_t^c} - \underbrace{\left({}^{a}\phi_t^s - {}^{r}\phi_t^s\right)}_{={}^{no}\phi_t^s}. \tag{B.1} $$

To highlight the distinction between the volume and substitution effects, we define a set of variables reflecting the ratios between international financial flows and the amount of savings available in the originating economic areas: ${}^{a}\rho_t^c = {}^{a}\phi_t^c / s_t^c$, ${}^{r}\rho_t^c = {}^{r}\phi_t^c / s_t^c$, ${}^{a}\rho_t^s = {}^{a}\phi_t^s / s_t^s$ and ${}^{r}\rho_t^s = {}^{r}\phi_t^s / s_t^s$. All these ratios are positive. Because of the common denominators, we can directly write two additional ratios: ${}^{no}\rho_t^c = {}^{a}\rho_t^c - {}^{r}\rho_t^c$ and ${}^{no}\rho_t^s = {}^{a}\rho_t^s - {}^{r}\rho_t^s$. Based on these definitions, we can intuitively introduce the volume and substitution effects. The former is viewed as the change in net financial flows to semi-periphery countries ${}^{n}\phi_t^{c,s}$ due

but (for the sake of simplicity and the needs of the identification strategy) exogenous from the viewpoint of semi-periphery countries. In this subsection, no distinction is made between the CLIF cycles and the industrial and financial cycles of all center economies. The former is considered as equivalent to the latter.

[18] Hypothesis 3.2 and its implications are based on the following simplification: we are in a model with two economic areas and the semi-periphery considered does not include China. In practice, the second hypothesis means that, because we exclude China due to its specific position as world-leader semi-periphery country and its intensive capital control policies, we neglect flows coming from and going to it. We also ignore financial flows from and to the periphery.

to a change in the volume of savings in center economies, Δs_t^c. The substitution effect is the variation of ${}^n\phi_t^{c,s}$ because of a change in the allocation of savings in center and semi-periphery economies, $\Delta^{no}\rho_t^c$ and $\Delta^{no}\rho_t^s$. Figure B-4 displays a representation of the effects depending on the phase of the CLIF cycles (the sign of A_t^c).

The interdependencies between the center and the semi-periphery are asymmetrical (see Sections 1.2.3 and 3.2). Mathematically, the changes in net financial flows to semi-periphery countries ${}^n\phi_t^{c,s}$ through the CLIF cycles can be approximated by:[19]

$$\frac{\partial\, {}^n\phi_t^{c,s}}{\partial A_t^c} \approx \underbrace{\left({}^a\rho_t^c - {}^r\rho_t^c\right)\frac{\partial\, s_t^c}{\partial A_t^c}}_{\textit{volume effect}} + \underbrace{\left(\frac{\partial\, {}^a\rho_t^c}{\partial A_t^c} - \frac{\partial\, {}^r\rho_t^c}{\partial A_t^c}\right) s_t^c}_{\textit{substitution effect 1}} + \underbrace{\left(\frac{\partial\, {}^r\rho_t^s}{\partial A_t^c} - \frac{\partial\, {}^a\rho_t^s}{\partial A_t^c}\right) s_t^s}_{\textit{substitution effect 2}} \tag{B.5}$$

This equation exhibits the three principal components affecting the evolution of financial flows to semi-periphery countries during CLIF cycles. Firstly, the volume effect, or alternatively the income effect, represents the decrease (resp. rise) of inflows due to the global contraction (resp. expansion) of investment during the downward (resp. upward) phase of CLIF cycles.[20] The central idea is that these cycles drive the amount of the global investment around the world because of the economic influence of the center. In other words, during expansions in CLIF cycles, firms typically have higher (financial and industrial) earnings to invest both at home and abroad.[21] Through this dynamic, we

[19]We assume that savings in the semi-periphery are relatively independent of the CLIF cycles. Specifically, the formal steps to obtain the decomposition of the changes in net financial flows to semi-periphery countries ${}^n\phi_t^{c,s}$ throughout the CLIF cycles are:

$$\begin{aligned}
\frac{\partial\, {}^n\phi_t^{c,s}}{\partial A_t^c} &= \left[\frac{\partial\, {}^a\phi_t^c}{\partial A_t^c} - \frac{\partial\, {}^r\phi_t^c}{\partial A_t^c}\right] - \left[\frac{\partial\, {}^a\phi_t^s}{\partial A_t^c} - \frac{\partial\, {}^r\phi_t^s}{\partial A_t^c}\right] && \text{(B.2)}\\
&= \left[\left({}^a\rho_t^c\frac{\partial\, s_t^c}{\partial A_t^c} + \frac{\partial\, {}^a\rho_t^c}{\partial A_t^c}s_t^c\right) - \left({}^r\rho_t^c\frac{\partial\, s_t^c}{\partial A_t^c} + \frac{\partial\, {}^r\rho_t^c}{\partial A_t^c}s_t^c\right)\right] \\
&\qquad - \left[\left({}^a\rho_t^c\frac{\partial\, s_t^c}{\partial A_t^c} + \frac{\partial\, {}^a\rho_t^c}{\partial A_t^c}s_t^c\right) - \left({}^r\rho_t^c\frac{\partial\, s_t^c}{\partial A_t^c} + \frac{\partial\, {}^r\rho_t^c}{\partial A_t^c}s_t^c\right)\right] && \text{(B.3)}\\
&= \left[\left({}^a\rho_t^c - {}^r\rho_t^c\right)\frac{\partial\, s_t^c}{\partial A_t^c} + \left(\frac{\partial\, {}^a\rho_t^c}{\partial A_t^c} - \frac{\partial\, {}^r\rho_t^c}{\partial A_t^c}\right)s_t^c\right] \\
&\qquad - \left[\left({}^a\rho_t^s - {}^r\rho_t^s\right)\frac{\partial\, s_t^s}{\partial A_t^c} + \left(\frac{\partial\, {}^a\rho_t^s}{\partial A_t^c} - \frac{\partial\, {}^r\rho_t^s}{\partial A_t^c}\right)s_t^s\right]. && \text{(B.4)}
\end{aligned}$$

[20]Global investment evolves procyclically with CLIF cycles as a direct consequence of Hypothesis 3.3; namely that $\frac{\partial i_t^g}{\partial A_t} > 0$, where the exponent g refers to global variables (sum of the center and the periphery).

[21]Another conventional salient phenomenon happens with financial crises. After financial domestic

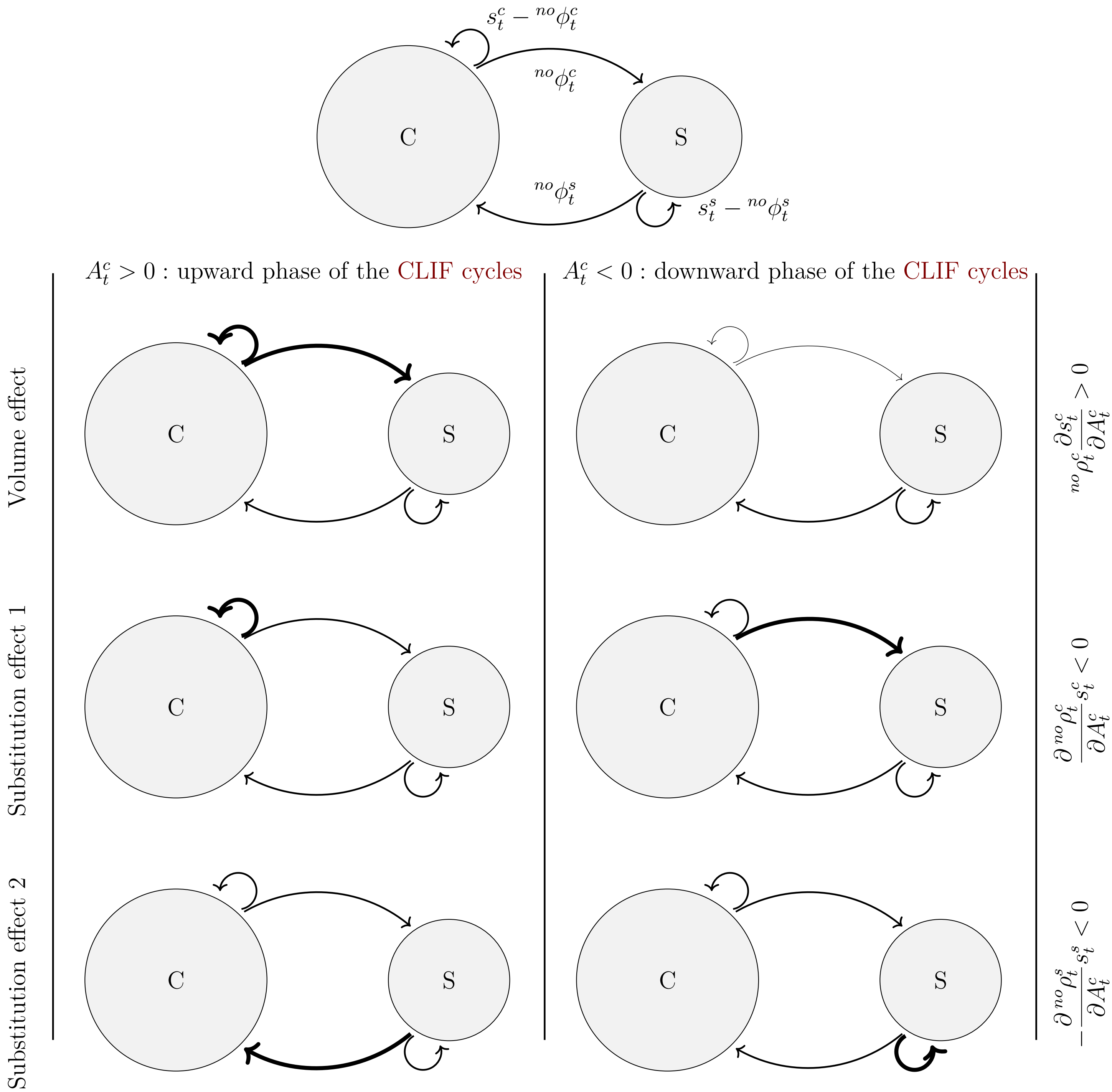

Figure B-4: Volume and substitution effects.

expect investment outflows of center economies evolve procyclically with CLIF cycles, and increase concurrently with their domestic investments. According to this argument, capital inflows of semi-periphery countries should display the same procyclical behavior extensively documented for domestic investment in center economies. More formally, the volume effect is defined as follows:

$$\left.\frac{\partial\, {}^{n}\phi_t^{c,s}}{\partial A_t^c}\right|_{\substack{{}^{no}\rho_t^c=\text{cst}\\ {}^{no}\rho_t^s=\text{cst}}} \approx \underbrace{\left({}^{a}\overline{\rho}^{c} - {}^{r}\overline{\rho}^{c}\right)}_{>0} \times \underbrace{\frac{\partial\, s_t^c}{\partial A_t^c}}_{>0} > 0. \tag{B.6}$$

Secondly, the substitution effect 1 refers to the modification of capital allocations by investors from the center due to the changes in CLIF cycles. Thirdly, the substitution effect 2 refers to the modification of capital allocations by investors from, respectively, the center and the semi-periphery due to the changes in CLIF cycles. The substitution effects are usually countercyclical with CLIF cycles and can be at the root of disruptive changes in the pattern of financial flows. To bring to light these elements, we outline the dynamics of substitution effects and introduce an additional key hypothesis. The two substitution effects can be viewed as symmetrical to one another so that a detailed description of both would be largely redundant. We assume that at least one of these two situations in not too distant from the truth: (i) the behaviors of investors in the center and in the semi-periphery are affected by CLIF cycles in a way that is quite similar to how their decisions on fund allocations between the two areas are affected, such as $\frac{\partial\, {}^{no}\rho_t^c}{\partial A_t^c} \approx -\frac{\partial\, {}^{no}\rho_t^s}{\partial A_t^c}$; and/or (ii) based on Hypothesis 3.3, we can assume that investment in the center is the main driver and that $s^g = s^c + s^s \approx s^c \gg s^s$, where the exponent g refers to global variables. We can therefore formulate that the overall substitution effect is approximated by:

$$\left.\frac{\partial\, {}^{n}\phi_t^{c,s}}{\partial A_t^c}\right|_{s^c=\text{cst}} \approx \underbrace{\overline{s}^{g}}_{>0} \times \frac{\partial}{\partial A_t^c}\left({}^{a}\rho_t^c - {}^{r}\rho_t^c\right). \tag{B.7}$$

stresses, center countries invest less and global liquidity decreases. Considering no change in the ρ_t, this causes a decrease in investment in the semi-periphery from the center. In some cases, this even leads to the repatriation of capital from the semi-periphery.

B.3.2 Limits to the countercyclicality

The main argument of the paper is that financial inflows in semi-periphery countries are countercyclical with CLIF cycles. This is due to the countercyclical forces driving the substitution effect such as highlighted in the core of this study. Yet, several other factors impacts the financial flows to the semi-periphery. In particular, some of these factors can have an opposite effect on the pattern. Therefore, the countercyclicity between the financial inflows in semi-periphery countries and CLIF cycles is far from a "pure phase opposition." These opposing and intertwined factors include:

1. Disruptive institutional, economic and political transformations that trigger massive changes in the expectations of international investors. For example, the collapse of the USSR considerably altered the international conditions. The recent conflict in Ukraine is another example. Likewise, geopolitical conflicts can create "geopolitical outliers" that would benefited financial aids (e.g., South Korea, Israel) or suffer embargo (e.g., Iran, Cuba). Generally speaking, these factors do not generate specifically countercyclical inflows to the semi-periphery.

2. Spatial and temporal disparities of pull factors. Several pull factors can accentuate the financial inflows to the semi-periphery but have regional disparities (e.g., an oil shock will affect net-oil exporters differently than net-oil importers). In addition, the timing of these pull factors can also decrease the countercyclicity; a smooth sequence of international and domestic pull factors is likely to generate a less "pure phase opposition" than a set of coordinated international and domestic pull factors synchronized with a decrease in CLIF cycles.

3. Magnitude of the volume effect. As highlighted in the core, the magnitude of the volume effect can affect the pattern of financial flows. A large contraction of center leader economies is likely to produce a short-term contraction in investments abroad, and then financial inflows to the semi-periphery.

4. Chaplet effect. A wave of financial crises in the semi-periphery can be characterized by a sequence of financial crises that would affect a set of related (geographically or economically) semi-periphery countries. The financial distress can shift from a recently very attracting country to another, with financial flows moving to these different places, and generate a smoother pattern that what would occur if these financial distresses were synchronized.

5. Different timings between different types of crises. The specific nature of the financial crises (banking crises, hyperinflation, etc.) that emerge from the distress of the balance-of-payment accounts might be different depending on the industrial and financial context of the economy and the period. These differences create additional heterogeneity that can "blur" a "pure" countercyclical effect.

6. Unlinearities between financial flows and CLIF cycles. The point of this study is to show and explain the countercyclicity. A pure phase opposition would rely on a linear opposition between the two phenomenon. Yet, many unlinear effects can occur, producing a distorting effect between the periodic dynamics.

7. Large investment of China. The recent period is characterized by rapidly rising financial investments by Chinese investors. It is not clear yet whether these investments follow a similar dynamics than those of the center leader countries analyzed in the study. Therefore, the contribution of China to international financial conditions can also alter the the countercyclicity between the financial inflows in semi-periphery countries and CLIF cycles.

8. Intra-center investments and financial hubs. A large share of global investment comes from and stays in center economies. Yet these investment might blur the relation highlighted in this study because a part of these investments can "go through" semi-periphery countries, for example for tax purposes. Combined these two effects might decrease the opposition between financial inflows in semi-periphery countries and CLIF cycles.

9. Importance of industrial policies. Many semi-periphery countries might have specific industrial policies that are partially uncorrelated with CLIF cycles. In addition, the timing of these policies can be dependent on the context. For example, the privatization of companies following the collapse of the USSR happened around five years earlier in Russia than in Ukraine, leading to different effects on the financial flows between these two countries.

B.4 Complements to the period (1990-2000)

B.4.1 Downward phase of the CLIF cycles

The early 1990s were characterized by simultaneous recessions in the US, the European, and the Japanese economies. Several center countries (France, Japan, etc.) experienced a very severe recession (zero or even negative growth). This economic contraction in the center brought down the utilization rate of production capacity and the profitability of investment. Interest rates fell throughout the 1990s in the center.[22] Scandinavian countries and Japan incurred large financial losses. European countries of the center experienced large unemployment rates and numerous currency crises in the early 1990s. The deteriorating macroeconomic conditions in the center triggered investment towards semi-periphery countries (Figure 3-7).

Stock prices and then real-estate prices in Japan sharply declined in the early 1990s.[23] The nascent recession meant that import growth slowed markedly while exports surged. In reaction, many Japanese firms greatly increased their efforts to sell abroad because the domestic markets for their products were growing less rapidly than the growth in their production capabilities. The slowdown in imports and the surge in exports meant that the Japanese trade surplus increased, which contributed to the higher prices of the yen, which

[22]A notable exception is Germany and its neighbors due to the macroeconomic policy of the German reunification between 1991 and 1993.

[23]The plunge was considerable and long-lasting. From late 1989 to August 1992, the Nikkei 225 fell 60 %. Ten years later, in February 2002, the Nikkei lost around 75 % of its peak value.

became a handicap for export-oriented Japanese firms. This reinforced the efficiency-seeking FDI outflows from Japan to China, Malaysia, Thailand, Indonesia, and nearby semi-periphery countries that had started in the late 1980s (Terry, 2002; Hatch, 2000). Since the Endaka, many Japanese enterprises had been regionalizing their production process by relocating labor-intensive activities in new subsidiaries set up in neighboring semi-periphery economies (Dieter, 2006).[24] This move was facilitated by Japanese ODA flows that financed infrastructure projects facilitating the regionalization of Japanese firms' production processes (Hatch and Yamamura, 1996). FDIs from Japanese firms attracted supplier firms and banks from Japan. The growth strategies of numerous semi-periphery East Asian countries were export-led, to insert in IPNs by hosting export platforms benefiting from the relatively low value of the domestic currency and wages.[25] Overall, many of these exports were produced by major MNEs headquartered in the Western economies and Japan, and to a lesser extent in Taiwan and South Korea (Dieter, 2006).[26]

The Volcker shock and the modernization and liberalization of financial services (notably the thrift institutions and the generalization of futures contracts) generated financial bubbles: the Savings and Loans crisis (1986-95) and Black Monday (the stock-market crash on October 19, 1987). Their bursting led to a period of recession in the US (Day, 2019). In early 1987, the Fed had raised the rate to deflate the Wall Street bubble (Stockman, 2013). Its burst in the fall of 1987, combined with the structural weaknesses generated by the transformation of the financial services, notably in banking and saving and loans and new stricter regulations on capital requirement, led in 1989 to a credit crunch (Hall, 1993) and an increase in short term interest rates (Aglietta and Valla, 2017). The Fed then adopted an accommodating policy and the Fed funds rate plummeted from over 9 % in 1989 to less than 3 % in 1993 (Figure 3-10). The recession and lower rates

[24]Due to the Endaka (the dramatic appreciation of the yen after the 1985 Plaza Accord), Japanese labor costs and trade frictions with Japan's Western partners rose.

[25]We can add that these large inflows from Japan led to increases in the prices of their currencies if they were floating and to increases in their central bank holdings of international reserve assets if these currencies were pegged.

[26]We can add that firms headquartered in South Korea began to invest in China and Indonesia because their wage rates were so much lower.

triggered major transfers to Latin America and Asian countries. A notable example was Mexico, which began to prepare for membership in the NAFTA (signed in August 1992). The crucial implications were that (i) the Bank of Mexico adopted a contractive monetary policy to reduce the inflation rate, (ii) hundreds of SOEs were privatized, and (iii) government regulations on international trade and business practices were liberalized. FDIs in Mexico surged as MNEs from center leader countries increased their manufacturing facilities in Mexico. A financial consequence is that US money market funds bought large amounts of peso-denominated securities because the interest rates were high and attractive. Likewise, US pension funds and mutual funds increased their purchases of "emerging equities."

The economic recession in Europe after 1990 triggered a shift from productive to financial investments. Many factors deteriorated the outlook of macroeconomic conditions in the area (e.g., Eichengreen, 2019a; Aliber and Kindleberger, 2017). Not only did European exports to the US slow down,[27] but the collapse of the USSR and the difficulties generated by the transition toward capitalism in the former Comecon economies generated a drastic reduction of consumption and investment that also affected Western European exports. German unification in 1990-91 generated a policy mix that led the Bundesbank to brutally increase its monetary policy interest rate, raising interest rates throughout the European Community and accentuating the difficulties of EU member states that chose to remain in the European Monetary System (EMS). Institutional changes in the EMS combined with the macroeconomic effects of German unification triggered major speculative attacks against EMS member states' currencies in 1992-93 (Eichengreen, 2008; Marsh, 2009; James, 2012).[28] In addition, after their financial deregulation, Scandinavian banks changed the composition of their assets towards a greater fragility. Financial bubbles in

[27]This was partially due to the weak dollar's decline (1990-1995) which led to higher REERs and undermined European competitiveness as well as the recession in the US.

[28]After the beginning of 1987, there were no more realignments of ERM currencies (starting the period of the "hard EMS"). Moreover, the progressive elimination of capital controls in the EU (completed in July 1990) rendered the realignments more difficult to effect. It resulted foreign exchange crises in the EMS. The sterling became floating again in September 1992. The crisis on the foreign exchange market leads to the widening of the fluctuation margins within the EMS in August 1993 (to + or - 15 %, against 2.25 % previously).

Finland, Norway, and Sweden burst between 1991 and 1993, resulting in severe credit crunches and widespread bank insolvencies.[29] These factors and the global recession elevated unemployment rates and discouraged productive investments in European center economies. The macroeconomic shocks generated financial flows out of Europe after 1993.

Finally, center economies in this period did not experience large financial disruptions in comparison to the prior period following the Volcker shock, from 1979 to 1981, or to the next period characterized by the GFC and subsequent and direct financial stresses, from 2007 to 2012. International liquidity did not therefore contract as much as during those two global financial disruptions, and the volume effect was less important.

B.4.2 Major pull factors

The debt crisis of the 1980s led most of the affected semi-periphery countries to a dismal financial situation (Serra and Stiglitz, 2008). The development of the Brady bonds in 1989-90 enabled many Latin American countries to convert impaired bank loans into long-term bonds partially guaranteed by the US government. The reshaping of the overhang of bank loans effectively removed these countries from their bankruptcy and greatly contributed to effectively ending their financial isolation from the global capital market.

Subsequently to the debt crisis, many semi-periphery countries changed their economic strategies and adopted structural reforms, often under the IMF guidance within the framework of SAP and as conditions on financial support. Many semi-periphery countries adopted policies to attract FDI and generate export platforms to diversify their exports and improve their trade balance. These policies included tax changes, the creation of free-trade zones and export-processing zones with specific tax and labor law rule,s and the improvement of transport infrastructure with some heterogeneities.[30] A common

[29] As an illustration, in Sweden, the share of government securities fell from 25 % of total bank balance sheets in 1983 to 11 % in 1992. Concurrently, the total of credit to the private sector jumped from 46 % to 60 %, the increase being concentrated on the real estate sector and financed by borrowings on the money market. The tightening of monetary policy then precipitated these crises. The cost of the rescue was very high. Overall, from the outbreak in 1990 to the consolidation of banks at the end of 1992, the banks' losses reached 8 % of GDP in Sweden and 15 % in Finland (Aglietta and Valla, 2017).

[30] For example, Collier and Gunning (1999) explain that: "*A common criticism is that the policies*

characteristic was a lack of distributional analysis and the promotion of market-based development strategies and premature financial liberalization (Collier and Gunning, 1999).

Numerous authors have pointed out the importance of multilateral and bilateral trade agreements.[31] Accession to the WTO is also seen is a significant institutional change that strengthened the resilience of IPNs such as Mexico in the late 1980s, Eastern Europe in the 1990s, and China in 2001. Particularly effective were the provisions that protected better investors and intellectual property, notably the Trade-Related Aspects of Intellectual Property Rights (TRIPs) and Trade-Related Investment Measures (TRIMs) in the 1994 Marrakesh Agreement (Hoekman and Kostecki, 2009).

Many semi-periphery countries were involved in extensive privatization activities in the 1990s, which attracted MNEs and investors based in center countries. SOEs in resource extraction, communications, manufacturing, and other industries were privatized (especially in Eastern Europe after the collapse of the USSR and in Latin America) and opened up to international private investors, and FDI negative lists were significantly reduced to open up new domestic industries for MNEs (Bulmer-Thomas, 2003; Berend and Berend, 2009; Oman, 1996a,b; Serra and Stiglitz, 2008) . A surge in investment inflows followed as investors from the center purchased shares in these firms.

Numerous semi-periphery countries liberalized their capital markets to attract portfolio investment, facilitating access to international credit for domestic banks and for local governments. Several of them, including Thailand, Russia, and certain countries in Latin America, created new financial markets in the 1990s in line with the process of privatizations.[32] Overall, the market capitalization of countries classified by the International

promoted by the IMF are virtually identical across countries. However, there is considerable heterogeneity. For example, IMF policies aimed to reduce real wages of public sector workers in Cote d'Ivoire, but to raise them in Uganda; to lower tax revenue in Zimbabwe, but to raise it in Ghana; and to introduce 'stabilising' windfall taxation of coffee exports in Uganda, but to avoid such taxation in Ethiopia."

[31] This was the case for Mexico with NAFTA in 1994, Turkey with its custom union with the EU in 1996, the Eastern European economies and their accession to the EU in the late 1990s and early 2000s, and the EPAs and FTAs between some Pacific Asian economies and Japan, the US and the EU. In parallel, although starting in 1968, the ASEAN became a true free trade area only in 1992.

[32] For example, stock markets received government licenses in Russia by the end of 1995, only one year after the end of the massive privatization program. The Prague stock market also began trading in September 1993, between two large waves of privatization (Rao and Hirsch, 2003).

Finance Corporation as emerging economies rose by 770 % from 1988 to 1996, and trading on stock markets rose by 380 % during the same period (Perotti and Van Oijen, 2001). Portfolio investments surged around some key places in the semi-periphery, and overall became much more important than bank loans (Figure 3-9). Another common domestic pull factor was the adoption of specific monetary policies in order to increase connections with the center's financial markets, such as pegging, the establishment of a currency board or the dollarization of the economy (e.g., the Argentina's Currency Board from 1991 to 2002), or reducing the inflation rate (e.g., Mexico). Moreover, large interest rate differentials existed between the center and the semi-periphery due to the high interest rates in some semi-periphery countries during the period, which encouraged carry trade investment by investors of center economies (see Figure 3-10).

B.5 Complements to the period (2000-2022)

As mentioned above in Subsection 3.3.3, the period 2001-2009 was dominated by a considerable volume effect. Therefore, the pattern developed in Subsection 3-1 was "postponed" and several semi-periphery economies experienced some financial difficulties in the direct aftermath of the financial crisis. This appendix provides some additional empirical elements on these dynamics and the general effects of the GFC on the semi-periphery, and therefore complement the discussion of the volume effect introduced in Subsection 3.3.3.

Additionally, because of both the considerable level of interventionism in financial regulation by the Chinese government (e.g., capital control and reserve accumulation) and its position of semi-periphery world leader country, only a few elements are developed on the Chinese economy in the core of this paper. Yet given the rising influence of the country, we complement the text with two discussions on the more recent events (the third period in Section 3.3). Firstly, we discuss the role of China on the commodity prices and the dynamic of the commodity boom that affected most semi-periphery countries in the 2000s and 2010s. Secondly, in line with the main arguments of this paper and in particular Proposition 3.1, we show that China experienced a financial distress in 2015 and 2016 - that is countercyclical to the event in center economies.

B.5.1 From the dot-com bubble burst to the consequences of the GFC

This subperiod started with the end of the second wave of BOP crises in semi-periphery countries.[33] Concomitantly, the US suffered from the burst of the dot-com bubble. We present here the direct implications of the 2007-09 GFC on semi-periphery countries. Overall, the 2000s and 2010s were characterized by a level of interconnection of financial markets and freedom of capital mobility that was unprecedented since 1914, partially due to the reforms engaged by numerous semi-periphery economies in the 1980s and 1990s as a result of the two first waves of financial crises. It was also characterized by a high level of liquidity and volatility. The rise of the financial sector in the economy, the rising importance of institutional investors and financial innovations provided increasing leverage and a greater variety of arbitrages all around the world.

Implications of the upward phase of CLIF cycles and pull factors before the GFC The dot-com bubble burst in 2000 and the US economy experienced serious over-capacities in numerous industries, notably steel and automotive (Aglietta and Berrebi, 2007; Artus and Virard, 2010). US macroeconomic imbalances were not fully corrected in 2001 because capital flowed into new bubbles and perpetuated the upward phase of the financial cycles of center economies (Figure 3-11). Institutional changes in the mortgage and real-estate markets in the early 2000s, notably but not only in the US, combined with accommodating monetary policies pursued by the Fed and other central banks of center economies generated several large real-estate bubbles (Rajan, 2011) and lowered real and nominal interest rates (Figure 3-14). Financial innovations (e.g., the emergence of CDS

[33] The last heavily affected semi-periphery countries were Argentina in 1998-2002 and Turkey in 2000-01.

and CDO) and the securitization of mortgage loans and MBS generated new injections of liquidity that accelerated the real estate bubble and generated a financial bubble as well (Roubini and Mihm, 2010; Chinn and Frieden, 2011; Aliber and Kindleberger, 2017). Savings from some center economies enjoying large trade surpluses (northern Europe, Northeast Asia, and some semi-periphery economies, notably China) were channeled into these bubbles, spreading the risks globally (Tooze, 2018). These bubbles also created transitory wealth effects that boosted consumption and reduced risk aversion.

During this upward phase of CLIF cycles, until the 2007-09 GFC, investment opportunities remained high in center economies (Figure 3-11) due to the financial and real bubble. Nevertheless, some semi-periphery economies attracted substantial financial flows (the volume effect), particularly in Europe, under the form of loans to the public sector (e.g., Greece, Portugal, Hungary) and to households or enterprises (e.g. Hungary, Spain, Romania, Baltic countries, Mexico).

As in the 1990s but on a smaller scale, FDI flows were encouraged in the 2000s by institutional reforms such as privatizations and regional integration schemes (notably the EU enlargements of 2004 and 2007, the creation and the extension of the Eurozone, and bilateral trade agreements between economies of the center and the semi-periphery).

After the second wave of BOP crises that hit numerous semi-periphery economies in the mid-1990s, three elements stabilized the situation in the 2000s. Firstly, governments from countries that had experienced macroeconomic stress devaluated their currencies to restore their trade balances from 1997 to 2000. Secondly, international commodity prices began to rise in the early 2000s. This was driven by the rising demand from the industrializing economies of East Asia (notably China), but also by the bubble and debt-driven consumption in Western economies of the center and by the financialization of commodities markets. Thirdly, as discussed, after two detrimental waves of BOP crises, several semi-periphery countries adopted policies securing substantial reserves of foreign exchange to avoid future speculative attacks on their currencies (e.g. Brazil) or conditional bail-outs (e.g., 1997 Asian crisis). Numerous semi-periphery countries' central banks (e.g., South Korea, Russia, India, Brazil) accumulated foreign exchange reserves and some invested abroad, notably in the US financial markets.[34] The semi-periphery's trade balance was large and positive (Figure 3-12), due largely to demand from the US and China.

Macroeconomic improvements in the semi-periphery Without creating large overoptimistic economic forecasts, unlike in the 1970s or the 1990s, the economic situation generated an improvement of macroeconomic fundamentals for numerous economies exporting raw materials or manufactured products bought by markets of center economies. This situation put an end to the second wave of BOP crises experienced in the 1990s by many countries of the semi-periphery. Several of those countries significantly increased their exports and their investments to center economies.

The liquidity glut generated by the accommodating monetary policy of center economies triggered a massive increase of debt in the center and in some semi-periphery economies (notably in the European semi-periphery). However, the policy-mix adopted by the countries who had been hit by financial crisis in the 1990s generated less opportunity for speculative financial inflows. Returns on financial investment were relatively more attractive in the real-estate and financial markets of the center. The significant financial outflows from the semi-periphery to the center, which facilitated the macroeconomic policies of some East Asian governments, fueled the bubbles of the center. The exception among the countries of the semi-periphery were those belonging to the EU or closely associated with the European Single Market (e.g. Iceland) and the Eurozone (e.g. some of the former Yugoslavian republics). In the European semi-periphery, the progress of economic integration generated by the enlargement and the European Monetary Union generated a higher degree of intra-EU capital mobility and a reduction of the exchange rate risk. This lowering of economic barriers generated a situation in which even a limited differential in interest rates and returns on investment could generate capital outflows

[34] This was facilitated by two factors: (i) the rise in commodity prices allowed some semi-periphery countries to increase export values; (ii) with investment falling relative to saving, current accounts moved into surplus (particularly significant for Asia after 1997).

from the EU member states that enjoyed a trade surplus and savings (De Grauwe, 2020; Artus and Gravet, 2012; Pisani-Ferry, 2011). This phenomenon generated massive intra-European financial loans, which in turn generated an unsustainable balance of payments when financial flows came to a sudden halt in late 2008 (Defraigne and Nouveau, 2021).

The direct impacts of the GFC on the semi-periphery The downturn of the real-estate market in the US triggered the burst of the global financial bubble. The creation of new bubbles after the burst of the dot-com bubble in 2000 enabled the US economy to postpone the difficult adjustments required to correct its macroeconomic disequilibria. However, as the macroeconomic imbalances were reinforced by the securitization and the shadow banking that channeled savings from the rest of the world to the US economy, in 2007 they generated a financial crisis of a magnitude unseen since World War II.[35]

The GFC generated a major deterioration of the balance sheet of banks, leading to a drying-up of the interbank loans markets and a search for liquidity. International banks repatriated liquidity from the semi-periphery and periphery, prompting capital outflows away from these areas.

Financial flows were not spread evenly among semi-periphery countries. Due to a deeper integration with the EU and the eurozone, semi-periphery economies from Eastern and Southern Europe had received important financial flows from Western European investors, but these ceased after 2008. In 2009, those economies from the European semi-periphery found themselves facing a debt and BOP crisis that required the support of the EU and/or the IMF. These constituted substantial push factors for investors, accentuating the financial flows out of the semi-periphery.

The aftermath of the GFC Governments and central banks were swift to launch interventionist policies and coordinate their actions at the multilateral level, including numerous semi-periphery economies with the creation of the G20. Governments of center economies organized a massive bailing-out of banks that mobilized about USD 3 trillion.

[35] This can be empirically assessed based on the medium-term cycles estimates (see Figure 3-11).

Some governments, notably the US, China, Japan, and Germany, launched exceptionally massive stimulus packages (Tooze, 2018; Defraigne and Nouveau, 2021). On the monetary front, central banks innovated by designing new instruments to provide the necessary liquidity to banks and private companies (e.g., see Rajan, 2011), while many interest rates were lowered close to the zero-lower bound (Figure 3-14). This constituted global injection of liquidity unprecedented since the industrial revolution in peacetime; the balance sheets of central banks from center economies increased fourfold in a decade. These reactions enabled these economies to avoid a situation similar to the Great Depression of the 1930s, but it also generated a greater liquidity glut once banks had cleared a large part of their toxic assets and non-performing loans from their balance sheets. The financial sector was partly stabilized by the spring of 2009, but the effects of the deleveraging and the credit crunch were strongly felt in center economies until the mid 2010s.

B.5.2 China's influence on semi-periphery countries

The impact of China on semi-periphery economies can be summarized by four dynamics. It contributed to the rapid recovery of the semi-periphery from the 2008 GFC by coming to the rescue of their exports. Likewise, China increased its investment in semi-periphery countries in the aftermath of the GFC. China also accentuated the "recommodification" of some semi-periphery economies. Finally, the China's economic slowdown contributed to the wave of financial distresses that affected the semi-periphery by its impacts on commodity markets. Overall, the influence of China on the rest of the semi-periphery was such that it participated in producing countercyclical financial flows to the semi-periphery relative to CLIF cycles.

Economic growth in China – a partial result of the government's massive stimulus package – is viewed as making a major contribution to preventing the global economy from plunging into a deeper recession and to support the exports of the semi-periphery and the periphery in the immediate aftermath of the GFC. More specifically, China is seen as having made an important contribution to the rapid recovery of the rest of the semi-periphery from the GFC by coming to the rescue of their exports – e.g., see publications by the Economic Commission for Latin America and the Caribbean (ECLAC) for Latin American and Caribbean countries.

Overcapacity in China and financial flows to the semi-periphery The aftermath of the GFC was a period of intense competition in China as Chinese private firms competed with both foreign investors and SOEs in some sectors. High levels of investment led to a massive expansion of industrial capacity, particularly in large-scale capital-intensive industries. This has led to "falling profit margins" and "the emergence of excess capacity in a number of industries in china including steel, cement, flat glass, aluminium, leather, and textiles. The high level of competition and overcapacity have increasingly led firms to seek new markets overseas where there is less competitive pressure and to export underutilized plant and equipment." (Jenkins, 2019)

This was particularly significant in mature industries such as textiles and garments, footwear, bicycles, and electrical appliances, with significant excess capacity. Overcapacity has been estimated at over 30 % for washing machines, 40 % for refrigerators, 45 % for microwave ovens and 87 % for televisions (OECD, 2008). The Chinese construction industry also experienced a high level of competition and market saturation at home, which has contributed to the expansion of the financing of overseas projects (Corkin et al., 2006; Corkin, 2008).[36] Likewise, among the Chinese firms investing in developing countries that responded to the 2010 survey by the China Council for the Promotion of International Trade (CCPIT) 54 % mentioned that the "stagnant domestic market" as either a decisive or an important factor in their decision to invest abroad. Moreover, 31 % of the firms replied that "avoid the saturated domestic market in China" was the main objective of their overseas investments (CCPIT, 2010). Gu (2011) and Shen (2014) also confirmed that domestic overcapacity and the opportunity to transfer domestic excess capacity abroad were significant contributing factors for international investments by Chinese firms during

[36] With its structural need for investment in infrastructure, African countries became one of the targets for Chinese construction companies in situation of overcapacity.

the period.

An additional evidence supporting the view that market-seeking investments triggered by domestic saturation in China occured during the period is that not all of the extracted natural resources owned by Chinese companies were exported to China. For instance, in Venezuela, around 50 % of the oil produced by Chinese firms were sold to the much closer US market because it was more profitable for these companies (Hogenboom, 2014). It seems that (in this case) the oil companies' private economic interests - potentially triggered by excess capacity at home - weigh more heavily than resource security.

The "recommodification" of some semi-periphery countries The shares of primary products in imports of China from many semi-periphery and periphery countries have increased substnatially in the 2000s and 2010s. These growing exports to China have led to the hypothesis of a 'recommodification' or 'reprimarization' of the economies involved and of their export structures (Rosales, 2016; SU, 2017; Jenkins, 2019)

Industrial policies in China promoting the domestic manufacturing sector made more difficult for semi-periphery and periphery economies to export processed goods to the Chinese market.[37]

However, it is certain that not all the blame should be put on China. In Latin America (as well as in other semi-periphery countries), a substantial deficit in infrastructure emerged in the 1980s following the debt crisis and the subsequent privatization of many SOEs and utilities. Public investments in infrastructure fell dramatically and was not compensated by an rise in private investments (Perrotti, 2011, Table 1). Likewise, the debt crisis led to a major economic reversal as most countries adopted the policies of trade liberalization. Tariffs in Latin America were reduced from an average of almost 60 % in 1985 to under 15 % a decade later, and many non-tariff barriers were also removed (Lora, 2011, pp.369–71). Latin American became much more open and the share of imported

[37]For instance, in the 1990s China promoted its domestic crushing industry through a variety of economic and political incentives and protectionist policies. It resulted that Chinese imports of soybean flour vanished and was replaced by imports of unprocessed soybeans. This, in turn, means that exports to China by Argentina and Brazil of processed soybeans decreased at a similar level and led to a partial deindustrialization of those economies.

goods increased. These factors contributed to a relative decline of the manufacturing sector in many of those countries that has been characterized as 'premature deindustrialization' (Palma, 2008; Rodrik, 2016a). This process, triggered by the switch in economic policies in the 1980s, was well under way when China joined the WTO and cannot be attributed to China.

A additional concern is the possibility that increased demand for commodities from China lead to a spread of Dutch Disease in semi-periphery and periphery economies. Several critics of the involvement of China in resource extraction abroad have argued that it has given rise to Dutch Disease in some semi-periphery and periphery countries (e.g., Zafar, 2007). This usually occurred where China considerably contributed to the development mining activities or new sources of raw materials (through direct trade and investment/lending), or where Chinese demand increased substantially global commodity prices (e.g., applied to all countries which exported minerals and metals). This might include South Africa, Brazil, Indonesia, India and Chile which experienced a significant appreciation of the REER) between 2001 and 2011 (Darvas, 2021).[38] Almost all oil net-exporter semi-periphery and periphery countries saw also their currencies appreciate over the period (but was mostly due to international condition because China contribution to the global oil price rise was less significant, see below). Trade with China has been identify as a significant factor - although other factors contributed to the REER appreciation, particularly high capital inflows due to the substitution effects triggered by the CLIF cycles. Yet, China decreases the probability of development of Dutch disease through its extensive use of commodity-backed loans and resources-for-infrastructure deals.[39]

Similarly, China exported its domestic overcapacity (see above). Large-scale industrial investment in China after the government's stimulus package has led to substantial excess capacity in many industries (Jenkins, 2019). Given that China accounts for a substantial

[38] We use here the REER as a measure of the potential existence of Dutch Disease in a country.

[39] This is because increased foreign exchange earnings are used to repay loans made by the Chinese policy banks to finance infrastructure. Indeed, in such situation the impact on expenditure within the host economy is relatively limited. It is then a mechanism enabling to avoid excessive currency appreciation in the short term, and increasing productivity of the economy replacing the exported natural capital with new forms of productive capital (Jenkins, 2019).

share of global production in several of industries (e.g., steel, aluminium, textiles), it then contributed to a situation of global overcapacity in semi-periphery countries. This put further pressure on international prices in these industries in the 2010s.[40]

Impact of China on the commodity market and the ending of commodity boom China's accession in 2001 to the WTO was followed by a decade-long boom in commodity prices. This was shortly interrupted in 2009 as a consequence of the GFC. It then resumed in 2010 and 2011. After 2011 commodity prices fell significantly.

The impact of China on the commodity boom has been differentied depending on the commodity involved. Based on China's share of global consumption and world trade, it is possible to distinguish five categories of commodities (Jenkins, 2019, Table 3.1). Firstly, China has a clear dominant position on both global consumption and world imports in several minerals and metals. In addition, China is highly dependent on imports. This particularly concerns iron ore, copper, and aluminium. According to Roberts et al. (2016), the most important driver of this considerable demand for minerals and metals is the high level of domestic investment in manufacturing, construction, and infrastructure. Since the late 1990s, the fast urbanization and residential construction accompanied by massive investment in transport and utilities in China triggered a rise in demand for minerals and metals. Chinese demand continued to grow faster than its domestic supply and China became increasingly dependent on imports during the 2000s and 2010s. Jenkins (2019) indicates that almost 90 % of iron ore, 66 % of copper and 46 % of aluminium used in China were imported in 2015. In this context, it is more than likely that China's economic slowdown and the decline in its aggregate demand had considerably impacts these markets and contributed to the ending of the commodity boom. Yet, we should also mentioned a supply-side effect that impacted the prices for metals. Indeed, IMF (2015b) showed that there was a substantial increase in supply resulting of large investment in new mines made during the period of high prices. When there mines were coming on

[40] This impact was felt particularly strongly in some industries (e.g., textiles) after China entered the WTO and can explain why it is not surprising that some they were among semi-periphery and periphery economies whose terms of trade deteriorated during the commodity boom, between 2002 and 2011.

stream and added a considerable downward pressure on prices. Secondly, China is a main global consumer and major importer of soybeans, fishmeal, cotton, hides and skins, and sawn wood. In contrast to feedstuffs (and partial wood), much of the growth of demand for the other commodities (cotton, skins, etc.) were driven by exports rather than to meet domestic demand. Therefore, changes in the world demand are more likely to have affected the prices of these commodities and China can be viewed as a major channel through which international conditions affected the commodity prices rather than the main source.

The third group is composed of oil and gas; two commodities for which China's share of global consumption and trade is relatively modest but are marked by a high level of dependence on import by China. This is a result of increasing energy use and car ownership. Although these commodities are of particular strategic interest for China and that it is likely to have a growing impact on the future, evidence suggest that China did have a major impact on world markets in the early 2010s.[41] The fourth category consists of commodities for which China is a major consumer because of its large population (grains, pig meat, and poultry) or its energy mix (i.e., for coal), yet is largely self-sufficient. This low level of dependence is mainly due to the government's food security strategy or its large domestic reserves. A consequence of that is that its share of global trade transactions for these commodities has remained relatively low (particularly relative to its global consumption share). It is therefore likely that China's impact on global markets was also relatively limited. The last group is made of commodities for which the share of global consumption and imports by China are relatively limited. This includes tropical products, such as bananas, coffee, and sugar, and beef. The impact of China on world markets was minimal for those commodities.

In practice, only a few semi-periphery and periphery economies were *directly* affected

[41] In the case of oil, for which China's influence on international market demand was in any case less than for minerals, several supply-side factors played a major role. For instance, this includes the decision by the OPEC to stop their attempt to maintain the price of oil, and the increased production of oil and gas from unconventional sources (shale and tar sands) in North America, which both were major causes of falling energy prices.

by China's rush for natural resources and its economic slowdown. During the 2000s, China's imports from Latin America increased massively, before falling in 2015, as both the Chinese and Latin American economies slowed down and global commodity prices fell sharply. Among the countries that relied the most on Chinese import are Chile, Cuba, Peru and Brazil.[42] In Sub-Saharan Africa, imports were concentrated in a few countries. South Africa, Angola, Sudan, and Republic of Congo accounted for around four-fifths of the total. Most exposed countries were oil exporters (e.g., Sudan, Angola, and Congo), mineral exporters (e.g., Democratic Republic of Congo (DRC), Mauritania, Zambia, and South Africa), and one wood exporter (Gambia). Even for such countries it is not clear whether the impact of China was that massive. For example, South Africa had well-established mining industries. In other circumstances, it would be able to find other markets for its minerals in the absence of China. Additionally, China did not played a major role in expanding supply, because Chinese FDI in mining were limited and mostly involved participation in joint ventures in existing mines.[43] Finally, we can add that Chinese imports of commodities continued to increase after the end of the commodity boom in around 2011 and other factors have then to be included to explain the end of that boom.

All those elements put together, the main impacts were on minerals and metals (notably iron, copper and aluminium), soybeans and sawn wood, with a weaker direct influence on oil and cotton. In addition, some supply-side effects and other international conditions played a major role. Therefore, except for few commodities, this does not seem likely that the reversal of the commodity boom was a result of domestic changes in China

[42]Only a small share of Latin American oil exports went to China and so its direct effects on the oil industry were weak. In contrast, imports of metals and minerals were much more important (e.g., Chile and Peru for copper and Brazil for iron ore). Even if copper and iron ore have deep alternative markets and are well standardized commodities, it's likely that China added a significant upward pressure on the prices of these commodities. China also had a direct effect on Brazil and Argentina through its large imports of soybeans from these two countries.

[43]This does not mean that some countries were not more impacted. In general, periphery economies seem to have been more impacted than semi-periphery economies. For instance, even in one of the most exposed country of Latin America, Chile (for which China is the first importer) only around a quarter of its exports went to China while it accounted for half the total exports of Mauritania, the Democratic Republic of the Congo (DRC), Sudan, and Angola.

since 2011.[44]

B.5.3 The financial distress of 2015-2016

The mid-2010s years were not only be difficult for nondominant semi-periphery countries. Indeed, China experienced major financial difficulties during the period. Even though China is a world leader country (based on our classification), it is still a semi-periphery economies and these difficulties are in line with the framework of this paper. Accordingly, the downward of the CLIF cycles triggered major inflows to China (in the aftermath of the GFC) that subsequently flowed out of the country and create a major financial stress (particularly in 2015 and 2016).

The downfall in the stock market and the downward currency pressures China's stock market started to slide on the 12th of June 2015. From its zenith at 5,166, the Shanghai Composite Index plunged plunged 30 % in three weeks and by mid-August it was at around 60 % of its peak value (a bit above 3,000) - despite the CCP-directed interventions of many companies and funds to pump billions of yuan in the stock market. It only temporarily stabilized. Indeed, on the 4th of January 2016, the downfall restarted and the following months additional waves of sell-off led to a further decrease in the index. At its nadir, the Shanghai Composite Index was down to around *half* of its zenith value (nearly six months earlier).

In the ending of 2015, the IMF was going to include the yuan in its Special Drawing Rights (SDR) basket.[45] A condition for being included in the basket was that China enable its currency to move more freely.Against the overvalued US dollar, the yuan had always been going up these last two decades. However in early August 2015 the yuan promptly plunged when the Chinese government liberalized currency trading transactions. This

[44]Yet it is completely true that had Chinese demand continued to grow as fast as it had before 2011, commodity prices would (other things being equal) have been higher. It is particularly true for minerals and metals. In addition, it is also correct that the influence of the subsequent slowdown of the Chinese economy added additional downward pressure on some commodities.

[45]It was approved by the Executive Board of the IMF on the 30th of November 2015, and was effective on the 1th of October 2016.

downward trend lasted around a year and a half and only reversed in mid-2017. From November 2014 to the beginning of 2017, the yuan lost around 15 % of its value (the first drop since the famous devaluation of 1994). Additionally, a huge amount of money was exiting China at a rate of hundreds of billions of US dollars per month, characteristics of a flight-to-safety.[46]

Based on the core arguments of this paper, one of the main reasons for the plunges in the stock market and the currency in China is the influence of the CLIF cycles.

The downward phase of CLIF cycles and financial inflows to China As explained in Subsection 3.3.3, several semi-periphery economies were in difficulties since the taper tantrum of 2013. This included Brazil and South Africa partially due to the commodity price collapse in 2014. Russia and numerous Central Asian countries were struggling with the low commodity price and were under additional pressure due to the economic sanctions and the Ukraine crisis. In Europe, Japan and the US, the growth was not particularly considerable such that a substantial and sustained force was China's continuous growth. In that context, during the years of incredible growth, the Chinese economy was characterized by a surge in credit since the GFC. Heavy industries built up huge overcapacities and the real estate sector was weighed down by overbuilding. The stock market had been pumped up by overoptimistic anticipations and dangerous margin lending. Likewise, China had an overinflated shadow banking sector (e.g., see Walter and Howie, 2012).

The logic driving China's financial integration and the boost of financial inflows was compelling for investors of the center economies. Chinese companies were investing massively. Despite the low interest rates in China, they were even lower in the center economies thanks to quantitative easing measures. It was rational that the time to think that the only probable movement in the yuan was upward. This tendency triggered a

[46]For more details, see "China Forex Reserves Fall USD 512.66 Billion in 2015, Biggest Drop on Record" *Reuters* (January 7, 2016) and "Asia Is Adding to Its FX Reserves in 2017 (China Included?)", *Follow the Money* (August 21, 2017) by Brad Setser.

surge in carry trade transactions.[47]

Despite its strong trade surplus, its ample foreign currency reserves and a constant appreciation of its currency, the Chinese economy had a key weakness. Since 2008, many banks, corporations and citizens accumulated debts in US dollars.[48] This made these actors vulnerable to a shift in the interest-rate differential between China and the US and/or a reversal in the direction of exchange-rate movements.

International and domestic push factors According to the BIS International Statistics, at the end of 2014, around 25 % of China's corporate debts were denominated in US dollar while only 8 % of their earnings were in that currency (most of which was owed to large Western banks). That means that if the value of the yuan had decreased, the debt burden of many already largely indebted actors would have increased - and turned some into insolvency - and many would have to deal with liquidity difficulties.

In 2015 few factors hit the Chinese economy. Firstly, the Fed tapered its QE policy; meaning that interest margins would be shifting in a adverse direction for the Chinese economy. Secondly, partially due to overcapacities, China's growth slowed down. Likewise, anti-corruption measures inside China caused wealthy families to move out of China their assets. Fourthly, the sudden collapse in oil prices in 2014 might have contributed to reverse the trend in commodity prices and to a even bigger retreat by some investors from their commodity-based carry trade strategies.[49] The outflows exerted a serious downward

[47] For instance, see "Is the $1tn China Carry Trade Imploding?" *Financial Times* (February 5, 2015).

[48] In 2008 China was not fully incorporated into this debt logic and dependence to the US dollar. Its economic integration was most dominated by trade account transactions. It was partially this characteristic that contributed to isolate China of the effects of the GFC and distracted investors of the center from the financial tensions building up when they were searching for higher yield in the aftermath of the GFC. However, after 2008, the Chinese modernization continued and the economy became more financial integrated to the global economy - and also more dependent.

[49] Due to its capital control policy, China linked its financial inflows to commodity prices. Indeed, if the exchange regulations was too difficult to circumvent and importing directly US dollars was challenging, the commodity market could help. The procedure was as follows (Tooze, 2018): borrow in dollars; buy commodities; use the expected receipts from the sale as a collateral to borrow in yuan; invest in yuan inside China. In doing so, carry trade investors could make money in three different ways; on the spread between Chinese returns and dollar funding costs, on the depreciation of the dollar against the yuan, and finally on the increase in the value of the commodities. Therefore, inflows were driven by booming Chinese demand and the volatility of commodity markets since 2014 (notably for oil transactions) was an additional destabilizing international push factor for the Chinese economy. In "normal" circumstances, it would have played the role of an international pull factor decreasing the price of imports for the Chinese

pressure on the yuan. Finally, these factors were very bad news and could have created a flight by anticipation or based on herd behaviours. In the context of the recent stimulus package that stimulated a credit boom, a recent rise in financial inflows, and a accentuation of the international of the yuan, these events triggered a major financial stress to the Chinese economy.

The effects of the COVID-19 crisis.

Two major difficulties in analyzing the most recent period are that fewer researches have been published on the period and the cycles associated with the period are not fully completed. Therefore, more cautious must be added.

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economy. Among other factors, this could also explain the rapid recovery despite the financial distress in 2015 and 2016.

Appendix C | Complements to Chapter 4

C.1 Details on data and samples

Tables C.1 and C.2 provide useful information on countries and monetary areas used in our samples. Details on the size, the time span and the countries included in each sample are given in Table C.1.

Sample	#Set	Start	Countries
Set 1 (baseline sample)	29	Jan1982	Algeria, Australia, Bangladesh, Belize, Canada, Denmark, Ecuador, Euro area, Gambia, Ghana, Guyana, India, Iran, Jamaica, Japan, Jordan, Lebanon, Malaysia, Mauritania, Mexico, Nepal, New Zealand, Norway, Sierra Leone, South Africa, Sweden, Switzerland, the UK, and the US.
Set 2	34	Nov1987	Set 1 + Colombia, Hungary, Iceland, Philippines, and Tunisia
Set 3	40	Jan1992	Set 2 + Indonesia, South Korea, Laos, Pakistan, Singapore, and Thailand
Set 4	47	Jan1994	Set 3 + Belarus, Czech Republic, Kazakhstan, Poland, Russia, Ukraine, and Uzbekistan
Set 5	62	May1995	Set 4 + Argentina, Bolivia, Brazil, Chile, El Salvador, and Peru + Azerbaijan, Egypt, Ethiopia, Israel, Kenya, Morocco, Saudi Arabia, Turkey, and Yemen
Set 6	66	Jan1996	Set 5 + Croatia, Haiti, Madagascar and Viet Nam
Set 7	75	Jan2001	Set 6 + Albania, Armenia, Kuwait, Kyrgyzstan, North Macedonia, Malawi, Moldova, Serbia, and Venezuela

Table C.1: Composition and time span of the different samples.

Table C.2 report key information on each monetary area taken into account in this paper; the ISO 3 label, the source and the specific nature of the interest rates collected, in which samples the monetary area is included, the base country, whether the monetary area is viewed as a core country and the time span of data availability. We include all countries which have sufficient amount of information available to be use in Set 7, meaning that we collected data for relevant short-term rates at least by 2001. In the dataset, some missing data have been replaced by linear interpolation. This only concerns a few gaps of few months.

Table C.2: Country list and sample details.

Monetary area	ISO3	Sets	Base country	Core	Availability MM-YYYY	Sources	Measures
Albania	ALB	7	USA	no	01–2001	Bank of Albania	official interest rate (1-week repo rate)
Algeria	DZA	1	USA	no	01–1963	Bank of Algeria	official interest rate (Discount Rate)
Argentina	ARG	5	USA	no	01–1979	Central Bank of Argentina (Banco Central de la República Argentina) and BIS dataset	official interest rates (various rates close to a 7-day repo rate)[a]
Armenia	ARM	7	USA	no	12–1999	Central Bank of Armenia	official interest rate (Refinancing Rate)
Australia	AUS	1	USA	yes	01–1968	BIS dataset and LJK macro finance analysis (for shadow rates)	official interest rates[a] and shadow rates[b]
Azerbaijan	AZE	5	USA	no	12–1992	Central Bank of the Republic of Azerbaijan and Macrobond	official interest rate (Refinancing Rate)
Bangladesh	BGD	1	USA	no	12–1971	Bangladesh Bank and Macrobond (before 2008)	main official policy interest rate (bank rate)
Belarus	BLR	4	USA	no	06–1991	National Bank of the Republic of Belarus	official interest rate (refinancing rate)
Belize	BLZ	1	USA	no	12–1977	Central Bank of Belize[c]	Interbank Rate for short-term loans between banks
Bolivia	BOL	5	USA	no	01–1990	Banco Central de Bolivia[c]	benchmark interest rate (at the discount window)

Brazil	BRA	5	USA	no	07–1986	BIS dataset	benchmark interest rate (official market intervention rate) before June 1996 and official interest rates after[a]
Canada	CAN	1	USA	yes	01–1956	BIS dataset and LJK macro finance analysis (for shadow rates)	official interest rates[a] and shadow rates[b]
Chile	CHL	5	USA	no	05–1995	Macrobond (before 1997) and BIS datasets	official interest rate[a]
Colombia	COL	2	USA	no	01–1986	OECD (before May 1995) and BIS dataset	official interest rate (1-day repo rate) after 1995
Croatia	HRV	6	EMU	no	02–1993	Croatian National Bank	main official interest rate (Overnight Credit Rate)
Czech Republic	CZE	4	EMU	no	01–1993	OECD (before Januaray 1996) and BIS datasets	Official interest rate (2-week repo rate)
Denmark	DNK	1	EMU	yes	03–1946	BIS dataset	official interest rate[a]
Ecuador	ECU	1	USA	no	01–1970	Banco Central del Ecuador	official interest rate (Benchmark Lending Rate, or Tasa Activa Referencial)
Egypt	EGY	5	USA	no	01–1991	Central Bank of Egypt	official interest rate (overnight deposit rate)
El Salvador	SLV	5	USA	no	01–1995	Central Reserve Bank of El Salvador	180-day deposit rate
Ethiopia	ETH	5	USA	no	01–1995	National Bank of Ethiopia	official interest rate (bank's savings rate)

Eurozone	EMU	1	/	yes	01–1960	BIS dataset and LJK macro finance analysis (for shadow rates)	official interest rate and shadow rates[b]
Gambia	GMB	1	GBR	no	12–1981	Central Bank of The Gambia and Macrobond	official interest rate (CBG's policy rate)
Ghana	GHA	1	USA	no	01–1964	Bank of Ghana and Macrobond	official interest rate (BG's Monetary Policy Rate)
Guyana	GUY	1	USA	no	03–1966	macrobond dataset	official interest rate (Bank Rate)
Haiti	HTI	6	USA	no	06–1995	Central Bank of Haiti (Banque de la République d'Haiti)	official interest rate (Repo Rate)
Hungary	HUN	2	EMU[d]	no	02–1987	BIS dataset	official interest rate[a]
Iceland	ISL	2	EMU	no	11–1987	OECD (before April 1998) and BIS datasets	official interest rate[a]
India	IND	1	USA	no	03-1946	BIS dataset	Official interest rates (Bank rate before April 2001; official repo overnight rate after)
Indonesia	IDN	3	USA	no	03-1989	Datastream (before January 1998), OECD (between January 1998 and July 2005) and BIS datasets	interpolation of quaterly data from datastream before 1998; benchmark or official interest rates[a] after
Iran	IRN	1	USA	no	07-1973	Central Bank of Iran[c]	benchmark interest rate

Israel	ISR	5	USA	no	01-1992	OECD (before August 1993) and BIS datasets	official interest rate
Jamaica	JAM	1	USA	no	01-1982	Bank of Jamaica	3-month bill rate before april 1994. BOJ policy rate after.
Japan	JPN	1	USA	yes	03-1946	BIS datasets and LJK macro finance analysis (for shadow rates)	official interest rate[a] and shadow rates[b]
Jordan	JOR	1	USA	no	12-1965	Central Bank of Jordan	Since February of 2015, official interest rate (Before February 2015, re-discount rate - with trend correction; CBJ Main Rate after)
Kazakhstan	KAZ	4	USA	no	01-1992	National Bank of Kazakhstan	official interest rate (refinancing rate before August 2015; overnight repo rate after)
Kenya	KEN	5	USA	no	01-1991	Central Bank of Kenya	official interest rate; Before August 2005, 91-day Treasury Bill (TB) rate, replaced by the Central Bank Rate (CBR) after.
South Korea	KOR	3	USA	no	03-1989	datastream (before 1991), OECD (between January 1991 and June 1999), BIS datasets	interpolation of quarterly data from datastream before 1999; official interest rates[a] after
Kuwait	KWT	7	USA	no	01-1999	Central Bank of Kuwait	official interest rate (discount rate)

Kyrgyzstan	KGZ	7	USA	no	01-2000	National Bank of the Kyrgyz Republic	official interest rate (NBKR policy rate)
Laos	LAO	3	USA	no	01-1992	Bank of the Lao People's Democratic Republic	official interest rate (short-term lending interest rate)
Lebanon	LBN	1	USA	no	01-1982	Banque Du Liban	official interest rate (Repo Rate)
Macedonia	MKD	7	EMU	no	02-2000	BIS dataset	official interest rate
Madagascar	MDG	6	EMU	no	01-1994	Central Bank of Madagascar	benchmark interest rate (CBM's official interest rate)
Malawi	MWI	7	USA	no	01-2001	Reserve Bank of Malawi	benchmark policy rate
Malaysia	MYS	1	USA	no	06-1981	Central Bank of Malaysia (Bank Negara Malaysia)	official interest rates (before 2004, 3-month interbank rate; Overnight Policy Rate after)
Mauritania	MRI	1	USA	no	01-1964	Central Bank of Mauritania	official interest rate (CBM's discount rate)
Mexico	MEX	1	USA	no	08-1975	OECD and BIS datasets	(less than 24h) Interbank Rate before December 1998 (OECD) and official policy interest rate[a] after (BIS)
Moldova	MDA	7	USA	no	01-2000	National Bank of Moldova	official interest rate (base rate)
Morocco	MAR	5	EMU	no	03-1994	Bank Al-Maghrib	official interest rate (key policy rate)
Nepal	NPL	1	IND	no	07-1976	Nepal Rastra Bank and Macrobond	official interest rate (NRB's bank rate)

New Zealand	NZL	1	AUS	yes	12-1973	OECD (before January 1985), BIS and LJK macro finance analysis (for shadow rates) datasets	official interest rates[a] and shadow rates[b]
Norway	NOR	1	EMU	yes	01-1964	OECD (before March 1986) and BIS datasets	official interest rates[a]
Pakistan	PAK	3	USA	no	03-1989	State Bank of Pakistan	After February 1991, (trend corrected) official interest rate (Before May 2015, trend corrected - meaning minus 1 - discount ceiling rate. SBP Policy rate after)
Peru	PER	5	USA	no	01-1995	datastream (before October 2003) and BIS datasets	interpolation of quarterly rates from datastream before October 2003; official interest rate after
Philippines	PHL	2	USA	no	02-1986	BIS dataset	official market intervention representative rate
Poland	POL	4	EMU	no	03-1991	OECD (before January 1993) and BIS datasets	Lombard rate (before February 1998) and official 7-day central bank bill yield after
Russia	RUS	4	USA	no	02-1992	BIS dataset	official interest rates[a]
Saudi Arabia	SAU	5	USA	no	01-1992	Saudi Arabian Monetary Agency	official interest rate (Official Market Repo Rate)

Serbia	SRB	7	EMU	no	02-1997	BIS dataset	official interest rate (central bank policy rate before January 1997; central bank discount rate after)
Sierra Leone	SLE	1	USA	no	11-1965	Bank of Sierra Leone and Macrobond	official interest rate (BSL's monetary policy rate)
Singapore	SGP	3	MYS	no	07-1987	Monetary Authority of Singapore[c]	(one of the benchmark interest rates) Interbank Overnight Rate Average
South Africa	ZAF	1	USA	no	01-1981	BIS dataset	official interest rate (official repo rate)
Sweden	SWE	1	EMU	yes	03-1946	BIS dataset	benchmark and official interest rates[a]
Switzerland	CHE	1	EMU	yes	03-1946	BIS dataset and LJK macro finance analysis (for shadow rates)	benchmark then official interest rates[a] and shadow rates[b]
Thailand	THA	3	USA	no	03-1989	datastream (before June 2000) and BIS datasets	interpolation of datastream quarterly rates before June 2000; Official market intervention representative rate, liquidity providing repo rates[a] after
Tunisia	TUN	2	EMU	no	01-1987	Central Bank of Tunisia (BCT)	Money market average interest rate before 2006. Official interest rate (Rate of call for tender) after
Turkey	TUR	5	USA	no	04-1986	Macrobond (before February 2002) and BIS datasets	official interest rates[a]
Ukraine	UKR	4	USA	no	06-1992	National Bank of Ukraine	official interest rate (discount rate)

UK	GBR	1	/	yes	03-1946	BIS dataset and LJK macro finance analysis (for shadow rates)	official interest rates[a] and shadow rates[b]
US	USA	1	/	yes	08-1954	BIS dataset and LJK macro finance analysis (for shadow rates)	official interest rates[a] and shadow rates[b]
Uzbekistan	UZB	4	USA	no	01-1994	Central Bank of Uzbekistan	official interest rate (Refinancing Rate)
Venezuela	VEN	7	USA	no	01-1998	Banco Central De Venezuela[c]	benchmark interest rate
Viet Nam	VNM	6	USA	no	01-1996	State Bank of Vietnam and Macrobond	official interest rate (Refinancing Rate)
Yemen	Yem	5	USA	no	01-1995	Central Bank of Yemen	official interest rate (benchmark deposit interest rate)

All these countries are part of those included in SET 1 to 7. Data are used to product main empirical results of this paper. The column *Monetary area* indicates monetary area names (meaning country names and the Eurozone). For the sake of simplicity and readability, but without lost of clarity, we shorted some country names. For instance, we noted *Iran* for *Islamic Republic of Iran*. The column *ISO3* refers the current officially assigned ISO 3166-1 alpha-3 codes, using the English short country names officially used by the United Nations to identify country. For the Eurozone, we use the three-letter acronym EMU for European Monetary Union. The Column *Sets* specifies the first sample which includes the interest rate of the associated monetary area. For example, a value 5 in this column means that interest rate of the monetary area are included in Set 5, 6 and 7. These inclusions are first and foremost based on data availability, and secondly on groupings of data based on geographical proximity. See Subsection 4.3.3 and Table C.1 for more information. Set 1 corresponds to the baseline sample used in Subsection 4.3.1, notably to generate results exhibited in Figure 4-2. The column *Base country* determines the base country associated with each monetary area (if relevant). As defined in the text, a base country is defined "*as the country that a home country's monetary policy is most closely linked with*" (Aizenman et al., 2008). Given the construction of the EMU interest rate before 1999, we consider EMU for countries having Germany as base country before. Base countries are based on Aizenman et al. (2008). The link is used to build the alternative spatial weighting matrix W_t^{BC} in Subsection C.7.2. The column *Core* indicates whether or not the country is considered as a core country. This is used to build the alternative spatial weighting matrix W_t^{core} in Subsection C.7.2. The column *Availability* specifies the beginning of the availability of collected data for the associated monetary area. The columns *Sources* and *Measures* refer to the sources of the collected data and the nature of the collected interest rates, respectively.

[a] More details on information provided for the BIS dataset's *Long series on central bank policy rates* can be found in www.bis.org/statistics/cbpol/cbpol_doc.pdf.

[b]More details about the definition and the computation of shadow policy rates can be found in Krippner (2013) and Wu and Xia (2016). The benchmark shadow rates used in this paper are those defined by Dr Leo Krippner and LJK Limited (`https://www.ljkmfa.com/`) for the US, the Eurozone, Japan, the UK, Switzerland, Canada, Australia and New Zealand). Alternative shadow rates have been tested and our results are similar. Another useful source is `sites.google.com/view/jingcynthiawu/shadow-rates`

[c]The Banco Central de Bolivia, the Central Bank of Iran, the Central Bank of Belize, the Monetary Authority of Singapore, the Central Bank of Venezuela do not use interest rates as a policy tool. Bolivia's, Belize's and Singapore's monetary policy has been based on exchange rate mechanisms. The Central Bank of Iran does not use the benchmark interest rate. Instead, the Central Bank of Iran sets the Bank Profit rates for lending and borrowing. The Central Bank of Venezuela is not responsible for setting interest rates. In a nutshell, the instrument used by the Bank to influence net domestic credit to the private sector was the issuance of its own securities. For details, see `www.bis.org/publ/plcy03k.pdf`

[d]According to Aizenman et al. (2008), Hungary starts having as base country Germany in 1992. A the sake of simplicity, we consider that its base country is the EMU.

C.2 Complements to the spatial weighting matrix

C.2.1 Selection and shape of the spatial weighting matrix.

We assume that the DGP is defined as:[1]

$$y_t = \bar{\rho}_t \bar{W}_t y_t + Z_t^{-1} \bar{\alpha}_t \mathbf{1}_n + \bar{\varepsilon}_t \tag{C.1}$$

where $\bar{\rho}_t$ is the true unknown time-varying cross-sectional spatial dependence parameter and $\bar{W}_t$ is the true time-varying normalized spatial weighting matrix which defines the specific shape or architecture of spillovers over time. $\bar{\alpha}_t$ is the true unknown time-varying intercept. $\bar{\varepsilon}_t$ is the true unknown disturbance vector. Therefore, $\bar{\rho}_t$ is an estimator that model the magnitude of spillovers over time based on the true network $\bar{W}_t$. The objective of our estimation process is to estimate $\bar{\rho}_t$.

Two main empirical difficulties come from the fact that we do not know: (i) what is the real transmission channel network. The shape of the matrix is unknown; nor (ii) the most adapted normalization for purpose of representing at best $\bar{W}_t$.

Regarding the first point, three standard strategies exist to determine an appropriate spatial weighting matrix: (a) the use a geographical matrix as the simplest way to model interaction distances; (b) the choice *a priori* of economic, politic and social data for availabilities and/or for theoretical reasons in order to model social and economic interactions; (c) the development of an statistical procedure to empirically build an estimate of a spatial weighting matrix. As above-explained, in spatial econometrics, the network structure must be specified *a priori* to build the weighting matrix and compute the spatial lag. Moreover, this research does not aim to propose a statistical procedure to build a network but rather suggest an statistical estimate of the monetary policy spillovers over time. We therefore rely on the second approach. International trade data are exploited to model a time-varying spatial weighting matrix. There are some major empirical arguments in

[1] It is based on common representations in spatial regression literature but in a time-varying framework.

favour of this estimate (see Subsection 4.2.4). Directly based on empirical data, we can build the time-varying unnormalized transmission channel matrix W_t^*.[2] In consequence, we assume that the *structure* of W_t^* is sufficiently close to the *structure* of $\bar{W}_t$ to estimate $\bar{\rho}_t$. We will here discuss the normalization issue in a time-varying framework.

C.2.2 Endogeneity concerns and evolution of W_t

Changes in international trade networks Geographical proximity is often an exogenous measure of distance. Spatial econometrics deals with the correlation that exists among neighboring units, assuming that these units cannot influence the region in which they are located. Our economic distance metrics can raise some endogeneity concerns, given that monetary policy in one area can affect trade and finance proximity. In order to minimize potential endogeneity concerns, it is common practice to use lagged weighting matrices (Blasques et al., 2016b). However, we use in this analysis contemporary matrices because we assume that the weighting matrices are exogenous.

The main argument is that the speed of the changes in the network is very low relative to the frequency of y_{jt}. Otherwise, the changes in the structure of international trade are very smooth relative to changes in monetary policy interest rates. This kind of network is then likely weakly affected by changes of entries y_{jt}. Hence, networks considered in this applications, based economic distance measures, are considered as exogenous.

We propose two simple approaches to assess changes in an economic-distance-based network. In this appendix, we only apply these approaches to the case of the international trade network The first approach consists to visualize the network at different period of times in order to assess whether or not major changes append and with which rate. This is exhibited in Figure C-2. The second approach is based on three proximity indexes, which measure how similar are two matrices. The network will be considered as exogenous if these three indexes decrease slowly over time.

The first index is called NSSD and is equal to a normalised sum of squared of differences

[2] In our modelization, w_{ijt}^* equals the addition of imports and exports between the country i and the country j at time t.

of the two matrices. The second is called the ECMN and corresponds to the expected correlation between products of matrices with a multivariate normal vector. The third index is the SSIM (Structural similarity) which comes from image engineering. The NSSD values are include in $\{0, 1\}$ while the two other indexes have values include in $\{-1, 1\}$. See below for more formal definitions of these indexes.

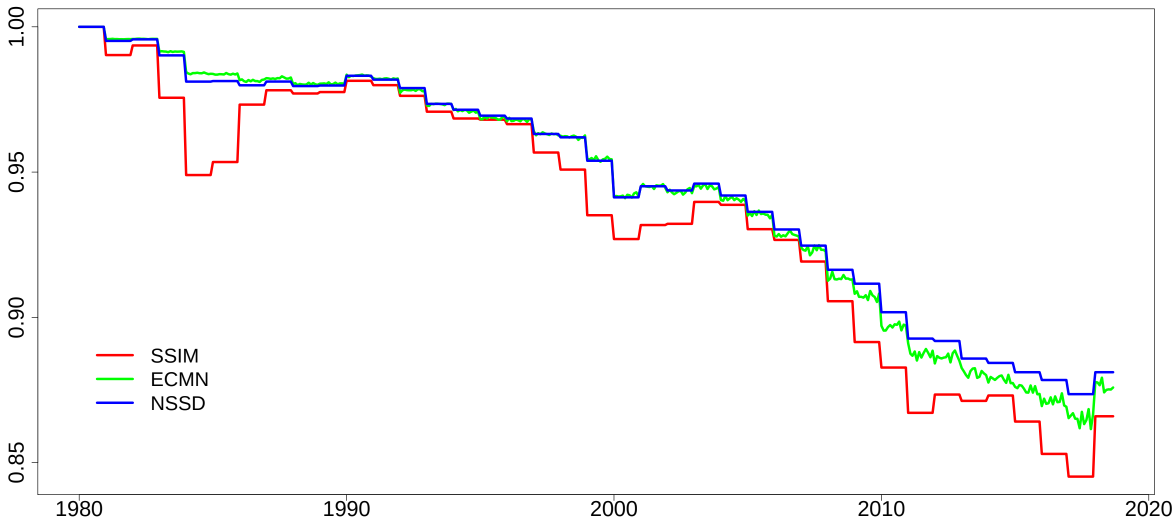


Figure C-1: Proximity indexes of trade matrices over time: $I^*_{t_1=1980,t_2=t}$.

Figure C-1 shows that, over the 40 years considered, these three proximity indexes decrease only very slowly and never drops below 0.85. Hence this network based on international trade measure can be considered in this econometric application as exogenous.

Definitions of matrix proximity indexes Consider two squared $n \times n$ spatial weighted matrices W_1 and W_2 (hence such as $W_{1,ii} = W_{2,ii} = 0, \ \forall i$). The NSSD, the ECMN and the SSIM indexes are defined as follows:

NSSD The *Normalized Sum of Squared Differences* is the most intuitive index. It consists to a normalized version of the sum of squared differences for these two matrices

$(W_{1,ij} - W_{2,ij})^2$ for all pairs $i, j \in \{1, \ldots, n\}$:

$$I_{1,2}^{NSSD} \equiv I^{NSSD}(W_1, W_2) \equiv 1 - \frac{\sum_{ij} (W_{1,ij} - W_{2,ij})^2}{\sum_{ij} W_{1,ij}^2 + \sum_{ij} W_{2,ij}^2} \tag{C.2}$$

Given that $W_{1,ij} \geq 0$ and $W_{2,ij} \geq 0$ for all $i, j \in \{0, \ldots, n\}$, hence $\sum_{ij} (W_{1,ij} - W_{2,ij})^2 \leq \sum_{ij} W_{1,ij}^2 + \sum_{ij} W_{2,ij}^2$. Therefore, the normalization is such that this index is formally between 0 and 1. If the difference is zero for each pairs, then the index equals one. It equals zero only if differences are orthogonal is a sense that $\sum_{ij} W_{1,ij} W_{2,ij} = 0$.

ECMN This index, acronym of *Expectation Correlation between products with a Multivariate Normal vector*, is defined as

$$I_{1,2}^{ECMN} \equiv I^{ECMN}(W_1, W_2) \equiv \mathbb{E}\{corr(W_1.u, W_2.u)\} \tag{C.3}$$

where $u \sim \mathcal{N}_n(0; I_n)$ is a multivariate normal. We used an approximation of this measure in taking the empirical mean of these correlation with 5000 occurrence of a multivariate vector. This is the reason of the small fluctuation of Figure C-1. As any correlation measure, this index is formally included between -1 and 1.

SSIM The *structural similarity index* comes from image processing (Wang et al., 2004) and provides a measure of the similarity by comparing two images based on three terms. It is a multiplicative combination of the luminance term l, the contrast term c and the structural term s:

$$I_{1,2}^{SSIM} \equiv I^{SSIM}(W_1, W_2) \equiv [l(W_1, W_2)]^{\alpha} [c(W_1, W_2)]^{\beta} [s(W_1, W_2)]^{\gamma} \tag{C.4}$$

where

$$l\left(W_1, W_2\right)=\frac{2 \mu_1 \mu_2+c_1}{\mu_1^2+\mu_2^2+c_1}, \quad c\left(W_1, W_2\right)=\frac{2 \sigma_1 \sigma_2+c_2}{\sigma_1^2+\sigma_2^2+c_2}, \quad s\left(W_1, W_2\right)=\frac{\sigma_{12}+c_3}{\sigma_1 \sigma_2+c_3} \tag{C.5}$$

where μ_1, μ_2, σ_1, σ_2, and σ_{12} are the local means, the standard deviations, and the covariance for (a "vectorization" of) matrices W_1 and W_2. If $\alpha = \beta = \gamma = 1$ (the default for exponents, which is used in this paper), and $c_3 = c_2/2$ (default selection of c_3, which is used in this paper) the index simplifies to:

$$I_{1,2}^{SSIM} \equiv I^{SSIM}\left(W_1, W_2\right) \equiv \frac{\left(2 \mu_1 \mu_2+c_1\right)}{\left(\mu_1^2+\mu_2^2+c_1\right)} \frac{\left(2 \sigma_{1,2}+c_2\right)}{\left(\sigma_1^2+\sigma_2^2+c_2\right)} \tag{C.6}$$

The constants c_1 and c_2 are used to resolve cases where in denominator is tending to zero. Here, this will never happen and we then take very small values ($c_1 = c_2 = 0.001$). Given the normalization process on spatial weight matrices, the first term of Equation C.6 is very close to one. We can rewrite an approximation of this index as $I_{1,2}^{SSIM} \approx 2\sigma_{1,2}/\left(\sigma_1^2 + \sigma_2^2\right)$. Here, this index is then mainly determined by relative magnitude of the covariance between the two "vectorized" matrices W_1 and W_2. This index is formally included between -1 and 1.

C.2.3 Assessing the economic integration

Based on a large set of indicators, Gygli et al. (2019); Potrafke (2015); Dreher et al. (2008); Carrieri et al. (2007); Dreher (2006) indicate that international economic integration, or economic globalization, has increased significantly over the last few decades, particularly in Europe, in North America and Southeast Asia. In what follows, we document this dynamic between 1982 and 2021 for trade connections as well as the structure of the spatial weighting matrix W_t. We show that, while economic relationships is still centered on few large economies, economic integration has become more and more multipolar, with an increasing number of large economic relationships between diverse countries. For the sake of simplicity and clarity, we break down the baseline sample into four sub-periods. The Figure C-2 displays the trade-based interaction scheme across monetary areas. Three major sets of observations can be made.

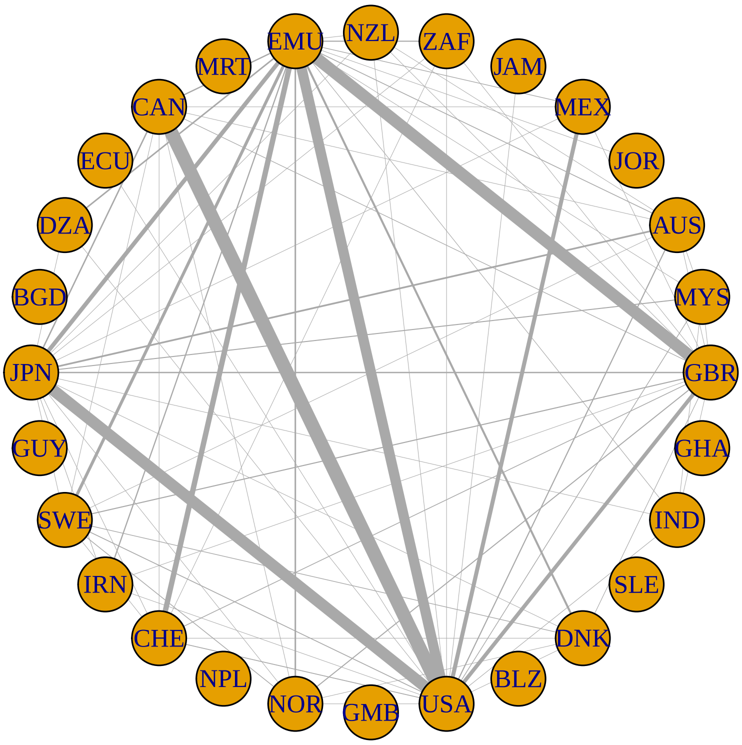
Firstly, as expected, a couple of core countries played a central role in international trade flows. The two main core monetary areas are the US and the Eurozone (EMU). A second layer of less influential but significant players is composed of Japan (JPN), the United Kingdom (GBR), Canada (CAN), Mexico (MEX) and, to a smaller extent, Switzerland (CHE). The Japanese influence has decreased over time, while that of Mexico has grown. The significance of the United Kingdom and Canada is large and stable over the period. Besides, Guyana (GUY), Belize (BLZ), Gambia (GMB), Nepal (NPL) and Sierra Leone (SLR) are unsurprisingly more weakly interconnected than others.

Secondly, the representation of trade connection exhibits reasonably stable transmission channels. The general shape of international trade flows between monetary areas analysed do not substantially change between 1982 and 2021. This is consistent with the view that the global influence of a country on monetary policies of their neighbourhood did not significantly evolves over the last three decades.[3]

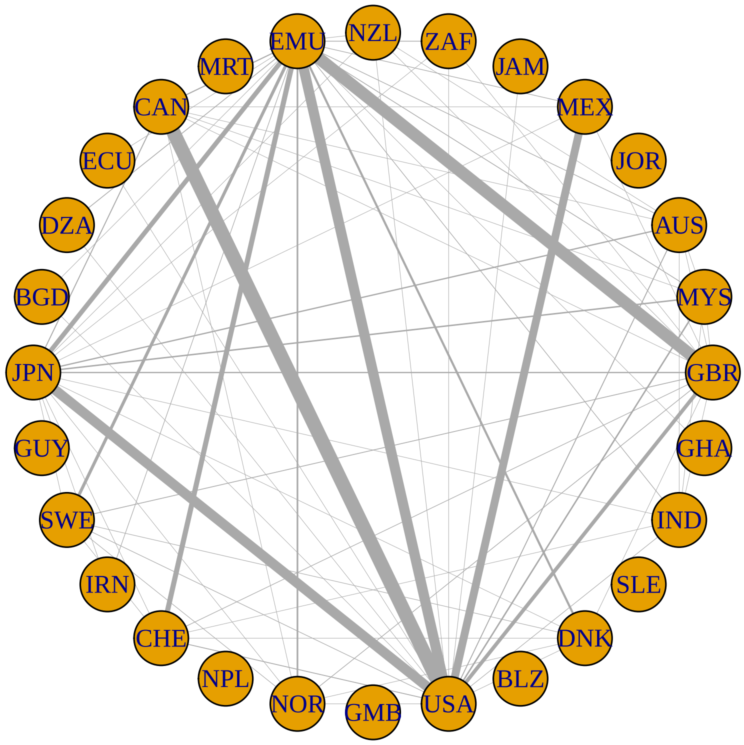
Thirdly, the integration processes occurring during these four decades is brought in light thanks to Figure C-2. From 1982 to 2021, we observe that the number of significant links increases. For instance, India (IND) has only five links in the first decade, while it is substantially connected to seven other areas in the second decade, 11 in the third, and 13 in the last decade. The same pattern can also be observed for example, for Mexico (MEX), Switzerland (CHE) and Malaysia (MYS).[4] Another manifestation of the rise in economic integration is the change in the relative magnitude of the two following links: USA-MEX and USA-JPN. As a result of the North American Free Trade Agreement (NAFTA), international trade between the US and Mexico increased significantly. On the other side,

[3]As above-mentioned in Subsection 4.2.4, this property is worth noticed as it make us confident that our spatial weighting matrix W_t can be considered as exogenous for the estimation of the spatial dependence parameter ρ_t. Details on the data-driven measurements of the stability over time of trade flows can be found in Appendix C.2.2.

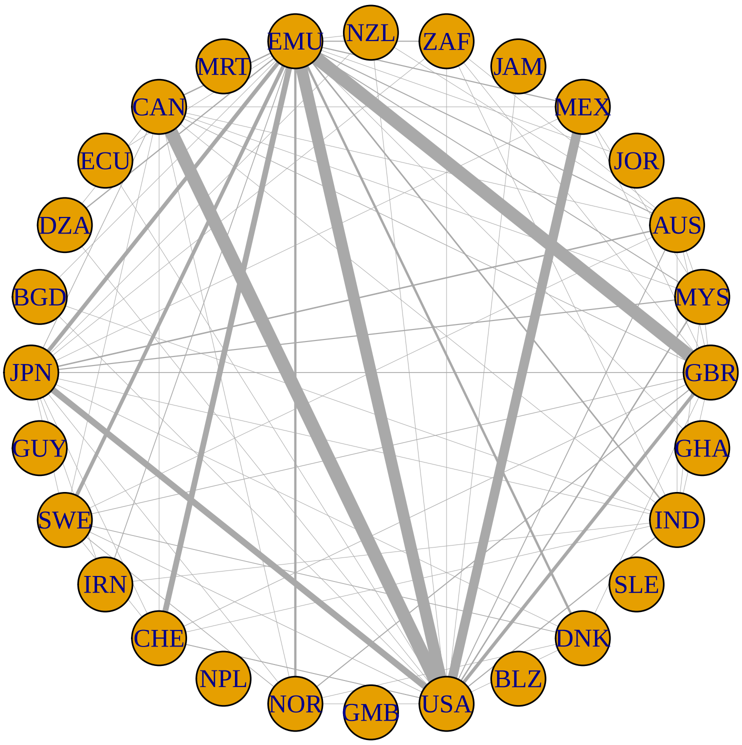
[4]This trend is robust to changes in samples and thresholds.



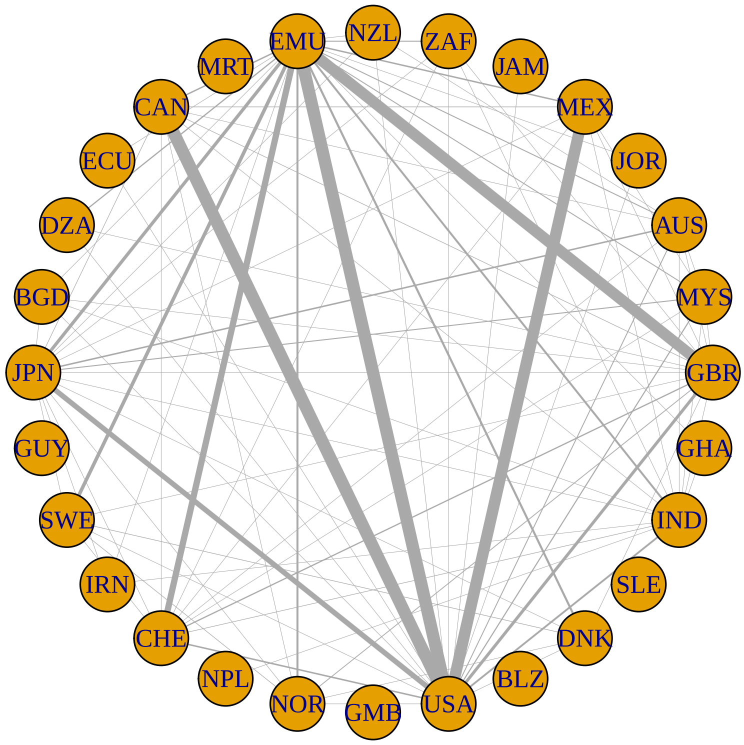
(a) 1982–1990



(b) 1991–2000



(c) 2001–2010



(d) 2010–2021

Figure C-2: Increasing Trade Interconnectedness and Mutlilateralism

Bidirectional weighting matrices built on gross bilateral trade. ISO3 acronyms can be find in Table C.2, Appendix C.1. Links lower than 0.1 % of the biggest links are not plotted for clarity.

Japan participated to regional integration processes making it less dependent from the United States. The increase in the economic integration among world economies is also captured by the sum of international trade flows, which has nearly quadrupled for our sample over the 1982-2021 period.[5]

C.3 Time-varying common trend and variance in presence of structural changes

Equation 4.2 is composed of a time-varying common trend (or time-varying intercept) α_t and a time-varying variance σ_t, which make the estimation procedure more complex to implement (relatively to a scenario of constant trend and variance). However, as exposed in Section 4.2.1, the dynamics of monthly policy interest rate (which are used as entries y_t) have greatly changed between 1985-1990 and 2013-2018. We explain here why it is crucial to have these time-varying parameters in presence of structural changes as in our data.

C.3.1 Time-varying common trend

In order to understand the usefulness of a time-varying common trend estimate in a time-varying spatial regression, we will consider a case where: (i) the weight matrix is constant and row-normalized,[6] (ii) the estimation procedure include a constant common trend, (iii) the data generating process include a time-varying common trend (iv) the magnitude around this trend is small relatively to the magnitude of this common trend, (v) no regressor.

Consider a scenario where the true DGP is $y_t = \alpha_t + \rho_t W y_t + \varepsilon_t$ but the supposed DGP assumes $y_t = \tilde{\alpha} + \rho_t W y_t + \varepsilon_t$. In both cases we consider here $\varepsilon_t \sim \mathcal{N}(0, \sigma^2 I_n)$. If we

[5] Taking 1982 as a normalisation reference, the values of the scale factor s_t are 2.02 in 1995, 2.98 in 2000, 3.64 in 2005, 3.71 in 2010 and 4.08 in 2017.

[6] Monte Carlo simulations enable us to confirm that the normalization procedure play no significant role in this debate. However, analytic results are easily obtain in situation of row normalization.

decompose entries y_t by the common trend α_t and the rest, y_t^*, the supposed DGP can be rewrited as $\alpha_t + y_t^* = \tilde{\alpha} + \rho_t (\alpha_t + W y_t^*) + \varepsilon_t$. Three cases happen:[7]

$\alpha_t \approx \tilde{\alpha}$: the variation of the time-varying common trend is small or we are in a specific time period were the time-varying common trend is close to $\tilde{\alpha}$. Then, the supposed DGP equation is equivalent to (or close enough to) the true DGP equation and there is not estimation bias;

$\alpha_t \gg \tilde{\alpha}$: the supposed DGP equation becomes $\alpha_t + y_t^* \approx \rho_t (\alpha_t + W y_t^*) + \varepsilon_t$. As supposed, $\alpha_t \gg y_t^*$ and hence the DGP relation can be approximate by $\alpha_t \approx \rho_t \alpha_t + \varepsilon_t$. In an asymptotic case, this lead to the estimation of $\hat{\rho} = 1$. In less extreme case, in periods were the true time-varying trend is higher than its mean $\alpha_t > \tilde{\alpha}$, the spatial dependence estimate $\hat{\rho}_t$ is overvalued.

$\alpha_t \ll \tilde{\alpha}$: the supposed DGP equation can be rewrite as $(\alpha_t + y_t^*) - \rho_t W (\alpha_t + y_t^*) \approx \tilde{\alpha} + \varepsilon_t$. As supposed, $\alpha_t \gg y_t^*$ and hence the supposed DGP equation can be approximated by $\alpha_t - \rho_t W \alpha_t \approx \tilde{\alpha} + \varepsilon_t$. In addition, we assume that the common trends are positive for each period: $\alpha_t, \tilde{\alpha} > 0$. This leads in an asymptotic case to the estimation $\hat{\rho}_t < 0$, whenever the value of ρ_t. In less extreme cases, in periods were the true time-varying trend is lower than its mean $\alpha_t > \tilde{\alpha} > 0$, the spatial dependence estimate $\hat{\rho}_t$ is undervalued.

This reasoning has been completed by numerous Monte Carlo simulations which have generalized and confirmed these intuitions: if the common trend of the true DGP is time-varying and positive and if the estimation procedure is build on the assumption of a constant common trend, hence the spatial dependence estimate will be overestimate in periods were the true time-varying common trend is above its mean value, and under-estimate in periods were the true time-varying common trend is below its mean value. In other words, the time-varying spatial correlation coefficient will be unbiased only in

[7] If the varying-time trend is not constant, there necessarily have some periods where $\alpha_t > \tilde{\alpha}$ and some others where $\alpha_t < \tilde{\alpha}$.

periods were the true time-varying common trend is close to its mean value. Moreover, simulations have enabled us to understand that this biases can be significant even for small variation in the common trend and happen with any kind of matrix normalization procedures.

C.3.2 Time-varying variance

The argumentation here is also mainly based on Monte Carlo simulations. Consider a scenario where the true DGP is $y_t = \alpha + \rho_t W y_t + \varepsilon_t$ with $\varepsilon_t \sim \mathcal{N}(0, \sigma_t^2 I_n)$ but the supposed DGP assumes a constant variance $\tilde{e}_t \sim \mathcal{N}(0, \tilde{\sigma}^2 I_n)$. We can decompose the true time-varying variance by a fixed and a variable component: $\sigma_t^2 = \tilde{\sigma}^2 + \sigma_t^{*2}$. Three cases happen:

$\sigma_t \approx \tilde{\sigma}$: the variation of the time-varying variance is small or we are in a specific time period were the time-varying variance is close to $\tilde{\sigma}$. Then, the supposed DGP equation is equivalent to (or close enough to) the true DGP equation and there is not estimation bias;

$\sigma_t \gg \tilde{\sigma}$: given the aforementioned decomposition, it means that $\tilde{\sigma}^2 + \sigma_t^{*2} \gg \tilde{\sigma}^2 \approx \hat{\sigma}^2$. The fact that the time-varying component is positive ($\sigma_t^{*2} \gg 0$) implies that a part of the true variance is not grasped by the estimated variance $\hat{\sigma}^2$. The estimation process[8] will associated this time-varying variability in data as a result of a strongest spatial correlation (only time-varying parameter in the model able to explain this change in the residual disturbance). This implies that when $\sigma_t \gg \tilde{\sigma}$ the estimation process overestimates ρ_t: $\hat{\rho}_t \gg \rho_t$.

$\sigma_t \ll \tilde{\sigma}$: given the aforementioned decomposition, it means that $\tilde{\sigma}^2 + \sigma_t^{*2} \ll \tilde{\sigma}^2 \approx \hat{\sigma}^2$. The fact that the time-varying component is negative ($\sigma_t^{*2} \ll 0$) implies that the estimated variance $\hat{\sigma}^2$ is locally overestimated. The estimation process will associated this lack of variability in data as a result of a smallest spatial correlation

[8] At least, the both processes discussed in this paper.

(only time-varying parameter in the model able to explain this change in the residual disturbance). This implies that when $\sigma_t \ll \tilde{\sigma}$ the estimation process underestimates ρ_t: $\hat{\rho}_t \ll \rho_t$.

As for the previous bias, this reasoning has been completed by numerous Monte Carlo simulations which have generalized and confirmed these intuitions: if the variance of the true DGP is time-varying and positive and if the estimation procedure is build on the assumption of a constant variance, hence the spatial dependence estimate will be overestimate in periods were the true time-varying variance is above its mean value, and underestimate in periods were the true time-varying variance is below its mean value In other words, the time-varying spatial correlation coefficient will be unbiased only in periods were the true time-varying variance is close to its mean value. Nevertheless, simulations have enabled us to understand that this biases is generally less significant that the bias generated by the time-varying-common-trend bias even if this magnitude can significantly vary according to simulations characteristics: number of cross-sectional entries y_{it}, shape of the weighting matrices, relative magnitude of the variance and the common trend component, etc. This bias can be significant even for small variation in the time-varying variance and happen with any kind of matrix normalization procedures. So, if σ_t widely varies, some periods will be overestimated, others will be underestimated.

C.4 Links spillovers/sensitivity and singularity/influence

C.4.1 Elements on the links between spillovers s_t and sensitivity θ_t

Subsection 4.2.5 mentions that (i) a few economic factors can affect and/or be affected by both the scale factor s_t and the sensitivity θ_t, and that (ii) we hypothesis that the sensitivity does not noticeably affect and/or is not affected by the synchronization of domestic factors which is driven by the economic integration. We detail these two points in the following paragraphs.

Firstly, more economic integration can be the fruit of many factors, including an increase in monetary cooperation that enables more stable cross-border financial and trade exchanges and therefore a rise in s_t. Likewise, more monetary cooperation leads unmistakably to more central banks' reactivity to the peers' monetary conditions and policies, which is likely to be linked with a rise of θ_t. Moreover, it also works the other way around. More economic integration can act as a trigger for more monetary cooperation due to the common issues that countries are likely to experience over time when they get more integrated. A higher level of reactivity by monetary authority can also be associated with a rise in the willingness of central bankers to move toward more monetary cooperation. Accordingly, more monetary cooperation increases s_t and θ_t and an increase in s_t and/or θ_t can lead to more monetary cooperation. Some technological changes and other monetary policy strategies as well as additional economic factors can affect and be affected by both s_t and θ_t. As an additional example, we can mention that the accumulation of reserve by some emerging countries might have led to (i) more economic integration because those countries were more confident to be able to manage disruptive international stresses and were then more likely to participate in trade or financial exchanges, and (ii) less reactivity because it enables some countries to be more isolate from international shocks.

Secondly, we need to highlight a key hypothesis on the role of the synchronization of domestic factors on the sensitivity and the scale factor to enable a proper identification strategy. The increasing synchronization of domestic factors, economic fundamentals or cycles, can be viewed as leading to more reactivity or sensitivity (an increase in θ_t). Indeed, two countries experiencing very close domestic cycles could react a change in the monetary policy of the other even more quickly and/or markedly than otherwise. In addition, both the the scale factor s_t and the sensitivity θ_t may cause more synchronization of domestic factors, fundamentals or cycles. Indeed, more economic integration (a higher value of s_t) implies more potential transmission of economic shocks and an increase in supply chain interdependence, leading to more synchronization in general. A higher sensitivity implies that central banks react more quickly, more in line and/or with more magnitude to other central banks' monetary policies. Almost directly by definition, an increase in the sensitivity will bring more synchronization of financial variables such monetary aggregates, inflations, etc. and then potentially to other domestic factors. Yet, it is important to notice that the influence of more synchronization on the sensitivity θ_t and the influence of it on the synchronization of fundamentals has, in both cases, to be considered as conditional to the level of economic integration. It means that a change in the sensitivity in itself will not change the synchronization or that the sensitivity will not be affected by a change in the synchronization of domestic factors because all the effects will be captured by the changes in the level of the economic integration that are perceived as the main root of this synchronization. Because the driving force of economic synchronization of domestic factors is more likely to be the direct consequences of more economic integration (e.g., Nguyen et al., 2020; Zelazowski et al., 2016; Duval et al., 2014; Kose et al., 2003), we hypothesis that the sensitivity does not noticeably affect and/or is not affected by the synchronization of those domestic factors that are driven by the economic integration.

This statement can me formulate more formally by considering the intensity of international monetary policy spillovers ρ_t as a function of multiple macroeconomic variables including the level of monetary accumulation between monetary areas, MC_t, the level of reserve accumulation, RA_t, and the level of synchronization of domestic fundamentals among connected economies, $synchr_t$:

$$\rho_t = f(MC_t, RA_t, synchr_t, X_t) + \varepsilon_t^{\rho} \tag{C.7}$$

where X_t is a set of other influential macroeconomic variables and ε_t^{ρ} is the disturbance (for example, due to microeconomic shock on a private bank). The hypothesis formulated here consists to say that we consider that the expectation of ρ_t conditional to s_t does not depend on $synchr_t$ such that we have the two following relationships:

$$E\left[\rho_t|s_t\right] = f'(MC_t, RA_t, s_t, X'_t) \qquad \text{and} \qquad \theta_t \approx E\left[\frac{\rho_t}{s_t}|s_t\right] = f'(MC_t, RA_t, X'_t) \quad \text{(C.8)}$$

with X'_t a subset of X_t. Similarly, $synchr_t$ is regarded as independent of θ_t when taken conditionally to s_t.

C.4.2 Elements on the links between singularity γ_t and influence μ_t

How does this indicator of global US monetary influence, μ_t, relate to the indicator of US monetary singularity, γ_t? We argue that the main impact of γ_t on μ_t is due to its effect on μ_t/ρ_t. To see this, we need to rewrite Equation 4.9 as follows: $\mu_t = \rho_t\left(\gamma_t + (1-\gamma_t)\varphi_t\right)$ where $\varphi_t = \sum_{i=1,j=j_{US}}^{n} w_{t;i,j}^{\text{multi}} / \sum_{\forall i,j} w_{t;i,j}^{\text{multi}}$ is the share of the US in international trade flows. Based on few simplifications, μ_t can be defined as follows $\mu_t = \rho_t\left[\varphi + \gamma_t(1-\varphi)\right]$, with ρ_t fixed.

For the sake of simplicity and conciseness, we made two assumptions. Firstly, we assume that the US account for a constant share of international trade during the period; meaning that φ_t is constant over time. In reality, it varies. For example, φ_t evolves in an approximate range of 0.20 to 0.28 with no clear pattern for the three first samples (sets I, II and III) and between 0.15 and 0.24 for the three last samples (sets V, VI and VII). Yet this simplification enables to focus on the role of γ_t and is not too different to our observations. Secondly, we suppose that the estimate of ρ_t is not affected by the value of γ_t. This last assumption is the most complex to grasp and is based on our empirical results. For example, the comparison between the left-handed charts in Figure 4-3 and Chart (b) in Figure 4-8 indicates a high level of similarities. To understand it, we have to remember that $\sum_{\forall i,j} w_{t;i,j}^{\gamma}$ is independent of γ. Then, ρ_t is allowed to capture the same spillovers, as long as the inclusion of W_t^1 in the model does not massively affect the level of spillovers estimated.

Given that $\varphi \in [0; 1]$, and around 0.15-0.3 for the US in our samples, we have that μ_t increases with γ_t, and more specifically that $\frac{\partial \mu_t}{\partial \gamma_t} = \rho_t(1-\varphi) > 0$. Therefore, the relative weight of the US influence on other monetary policies can decrease, $\frac{\partial \gamma_t}{\partial t} < 0$, without generating a decrease in the absolute global influence of the American monetary policy on others, $\frac{\partial \mu_t}{\partial t}$, if the overall size of the international monetary spillovers rose during that period, $\frac{\partial \rho_t}{\partial t} > 0$. As seen previously, this can be caused by an increase in the sensitivity to monetary policy, θ_t, and/or the scale factor, s_t (meaning more economic integration).

C.5 Complements to the LKSR estimation procedure

Section C.6.1 presents and analyzes the statistical properties of the different estimation procedures via Monte Carlo Simulations.

C.5.1 Estimation procedure: Local Kernel Spatial Regressions

Local kernel regressions usually performs in a local manner, i.e., the value of the estimated coefficient at a query location (or time) is only influenced by the information within a narrow neighborhood of that position. This idea of local smoothing and local approximation is so natural that it has appeared in many branches of science. As an illustration, this method has been largely adopted in statistics (Loader, 2006; Nadaraya, 1964; Watson, 1964) or in engineering (Brown, 1963; Savitzky and Golay, 1964).

A famous application of the time-varying local kernel regression is the *time-varying rolling window OLS estimator*.[9] It usually takes the following form (Inoue et al., 2017):

$$\hat{\beta}_T = \left(\sum_{t=T-h/2}^{T+h/2} X_t X_t' \right)^{-1} \left(\sum_{t=T-h/2}^{T+h/2} X_t y_t \right), \tag{C.9}$$

Where h is the bandwidth (i.e., a scale factor, also called the window length). In order

[9] In rolling-window OLS estimator, the kernel is constant.

to estimate β at time T, this method only takes into account the available information within a narrow neighborhood, from $T - h/2$ to $T + h/2$. More sophisticated methods adapt the weight of the information depending on its proximity to the estimation time T. Basically, it gives more weight to values closer to T, thanks to non-constant kernel.

The main advantage of this methodology lies in its ability to reduce the probability of model overfitting (Ashley et al., 1980). It has become very popular in economics and finance to improve forecasting performance (Stock and Watson, 2003, 2007), particularly in presence of structural changes. In addition, local kernel regressions are particularly suitable to estimate time-varying parameters.

By the same token, we develop a time-varying local kernel spatial semi-parametric regression. For each period t, we estimate a spatial dependence coefficient $\hat{\rho}_t$, a $k \times 1$-vector of regressor coefficients $\hat{\beta}_t$, an intercept coefficient $\hat{\alpha}_t$ and a variance coefficient $\hat{\sigma}_t$. The global estimation process is given by:

$$\{\hat{\rho}_t, \hat{\beta}_t, \hat{\alpha}_t, \hat{\sigma}_t\} = \arg\max_{\rho,\beta,\alpha,\sigma} \sum_{\tau=t-h/2}^{t+h/2} l(\rho, \beta, \alpha, \sigma | y_\tau, X_\tau) K_h(t-\tau) \qquad \forall\, t \tag{C.10}$$

where $K_h(\cdot) = K(\cdot/h)$ is the kernel function and is, as usually, chosen to be a smooth unimodal and symmetric function with a peak at 0. We impose an additional normalization condition such that $\sum_x K(x) = 1$. The log-likelihood function l is given by:

$$\begin{aligned} l(\rho, \beta, \alpha, \sigma | y_t, X_t) &\equiv \log p\,(y_t \mid \rho, \beta, \alpha, \sigma; X_t) \\ &= \log p_e(y_t - \rho W_t y_t - Z_t^{-1} \alpha \mathbf{1}_n - X_t \beta \mid \sigma^2 I_n; \lambda) + \log \mid I_n - \rho W \mid . \end{aligned} \tag{C.11}$$

C.5.2 The implementation of Local Kernel Spatial Regression

Given Equations 4.4 and 4.5, the estimation process behind the Local Kernel Spatial Regression is:

$$\begin{aligned}\{\hat{\rho}_t, \hat{\beta}_t, \hat{\alpha}_t, \hat{\sigma}_t\} &= \arg \max_{\rho,\beta,\alpha,\sigma} \mathcal{L}_t(\rho, \beta, \alpha, \sigma \mid y_t^b, X_t^b, W_t^b; \lambda) \\ &= \arg \max_{\rho,\beta,\alpha,\sigma} \sum_{\tau=t-b}^{t+b} K_{h,t}(\tau) \left[\log \mid I_n - \rho W_\tau \mid + \log p_e(e_\tau \mid y_\tau, X_\tau; \Sigma; \lambda)\right] \quad \text{(C.12)}\end{aligned}$$

where $y_t^b = \{y_{t-b}, y_{t-b+1}, \ldots, y_{t+b-1}, y_{t+b}\}$, $X_t^b = \{X_{t-b}, X_{t-b+1}, \ldots, X_{t+b-1}, X_{t+b}\}$ and $W_t^b = \{W_{t-b}, W_{t-b+1}, \ldots, W_{t+b-1}, W_{t+b}\}$. The disturbance vector is $\varepsilon_t = y_t - \rho W_t y_t - Z_t^{-1}\alpha\mathbf{1}_n - X_t\beta$. The kernel function $K_{h,t}(\cdot) = K_h(\cdot - t) = K(\frac{\cdot - t}{h})$ is such that $\sum_x K(x) = 1$. The bandwidth is given by $h = 2b+1$ and $b \in \{1, 2, 3, 4, \ldots, \frac{T-1}{2}\}$. This four-dimensional optimization problem have to be solved for each period $t \in \{1+b, 2+b, \ldots, T-b-1, T-b\}$. The unknown covariance matrix is simply $\Sigma = \sigma^2 I_n$.[10] The aim of this section is to expose how to transform this complex problem in a single-dimensional optimization problem in the case of a Normal distribution for the disturbance vector.

In the specific case where the disturbance vector ε_t is normally distributed, the log-likelihood function becomes:[11]

$$\begin{aligned}\mathcal{L}_t(\rho, \beta, \alpha, \sigma) &= \sum_{\tau=t-b}^{t+b} K_{h,t}(\tau) \left[\log \mid I_n - \rho W_\tau \mid - \frac{1}{2} e_\tau^T \Sigma^{-1} e_\tau - \frac{1}{2} \log \mid \Sigma \mid - \frac{n}{2} \log(2\pi)\right] \\ &= \sum_{\tau=t-b}^{t+b} K_{h,t}(\tau) \log \mid I_n - \rho W_\tau \mid - \frac{n}{2} \log\left(\sigma^2\right) - \frac{n}{2} \log(2\pi) - \frac{1}{2\sigma^2} \sum_{\tau=t-b}^{t+b} K_{h,t}(\tau) \sum_{i=1}^{n} e_{i\tau}^2.\end{aligned} \quad \text{(C.13)}$$

Assuming that the log-likelihood function L_t is convex, because its derivative exists, estimates $\{\hat{\rho}_t, \hat{\beta}_t, \hat{\alpha}_t, \hat{\sigma}_t\}$ are such that $\nabla \mathcal{L}_t(\hat{\rho}_t, \hat{\beta}_t, \hat{\alpha}_t, \hat{\sigma}_t) = 0$.

We can obtain that estimate $\hat{\beta}_t$ conditionally to the knowledge of the optimal values

[10] Generalization to a more complex covariance matrix structure is straightforward.

[11] For the sake of simplicity, we omit the conditionally with respect to y_τ, X_τ and λ for the rest of this section.

of ρ and α in taking the derivative with respect to β:

$$\frac{\partial}{\partial \beta}\mathcal{L}_t = -\frac{1}{\sigma^2}\sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\sum_{i=1}^{n} e_{i\tau}\frac{\partial e_{i\tau}}{\partial \beta} = 0 \tag{C.14}$$

$$\Leftrightarrow \quad \hat{\beta}_t(\rho,\alpha) = \sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\left[\left(X_\tau^T X_\tau\right)^{-1} X_\tau^T\,(I_n - \rho W_\tau)(y_\tau - \alpha \mathbf{1}_n)\right] \tag{C.15}$$

We can do the same operation for $\hat{\alpha}_t$:

$$\frac{\partial}{\partial \alpha}\mathcal{L}_t = -\frac{1}{\sigma^2}\sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\sum_{i=1}^{n} e_{i\tau}\frac{\partial e_{i\tau}}{\partial \alpha} = 0 \tag{C.16}$$

where $e_{i\tau} = y_{i\tau} - \rho\,[W_\tau y_\tau]_i - [1-\rho W_\tau \mathbf{1}_n]_i\,\alpha - [X_\tau\beta]_i$ and $\frac{\partial e_{i\tau}}{\partial \alpha} = -\,[1-\rho W_\tau \mathbf{1}_n]_i = -1 + \rho\sum_{j=1}^n W_{ij\tau}$. The notation $[A]_i$ indicates the i^e value of the column vector A.

$$\Leftrightarrow \quad \sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\sum_{i=1}^{n}\left[y_{i\tau} - \rho\,[W_\tau y_\tau]_i - \left(1-\rho\sum_{j=1}^{n} W_{ij\tau}\right)\alpha - [X_\tau\beta]_i\right]\left(1-\rho\sum_{j=1}^{n} W_{ij\tau}\right) = 0 \tag{C.17}$$

$$\Leftrightarrow \quad \sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\sum_{i=1}^{n}\left[\left(1-\rho\sum_{j=1}^{n} W_{ij\tau}\right) y_{it} - [X_t\beta]_i\right]\left(1-\rho\sum_{j=1}^{n} W_{ij\tau}\right) = \alpha\sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\left[\sum_{i=1}^{n}\left(1-\rho\sum_{j=1}^{n} W_{ij\tau}\right)^2\right] \tag{C.18}$$

$$\Leftrightarrow \quad \hat{\alpha}_t(\rho,\beta) = \frac{1}{a_1^t(\rho)}\sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\sum_{i=1}^{n}\left[a_{i\tau}(\rho)y_{i\tau} - b_{i\tau}(\rho,\beta)\right] \tag{C.19}$$

where $a_{i\tau}(\rho) = \left(1-\rho\sum_{j=1}^n W_{ij\tau}\right)^2$. The weighted sum of all these elements are $a_1^t(\rho) = \sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\sum_{i=1}^n a_{i\tau}$. The part depending of β is given by $b_{i\tau}(\rho,\beta) = \left(1-\rho\sum_{j=1}^n W_{ij\tau}\right)[X_\tau\beta]_i$.

Concerning $\hat{\sigma}_t^2$, derivative operations are more straightforward:

$$\frac{\partial}{\partial \sigma^2}\mathcal{L}_t = -\frac{n}{2}\frac{1}{\sigma^2} - \frac{-1}{2(\sigma^2)^2}\sum_{\tau=t-b}^{t+b}\sum_{i=1}^{n} K_h\,(t-\tau)\,e_{it}^2 = 0 \tag{C.20}$$

$$\Leftrightarrow \quad \hat{\sigma}_t^2(\rho,\alpha,\beta) = \frac{1}{n}\sum_{\tau=t-b}^{t+b} K_h(t-\tau)\sum_{i=1}^{n} e_{it}^2 = \sum_{\tau=t-b}^{t+b} K_h(t-\tau)\frac{\varepsilon_t^T\varepsilon_t}{n} \tag{C.21}$$

Once we have obtain functions $\hat{\beta}_t(\rho,\alpha)$, $\hat{\alpha}_t(\rho,\beta)$ and $\hat{\sigma}_t^2(\rho,\alpha,\beta)$, two ways to solve the optimization problem given by the Equation C.12 are possible: (i) transform this 4-dimensional problem in a 1-dimensional one; (ii) find the solution of $\frac{\partial}{\partial\rho}\mathcal{L}_t = 0$ and solve the system of 4 equations with 4 unknowns. Here, we propose to use the first method.[12]

By direct substitution of $\hat{\beta}_t(\rho,\alpha)$ in $\hat{\alpha}_t(\rho,\beta)$, we obtain the function $\hat{\alpha}_t(\rho)$:

$$a_1^t(\rho)\alpha = \underbrace{\sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\sum_{i=1}^{n} a_{i\tau}(\rho)y_{i\tau}}_{a_2^t(\rho)} - \sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\sum_{i=1}^{n}\left[(I_n-\rho W_\tau)X_\tau\beta\right]_i \tag{C.25}$$

[12]We choose this alternative because all functions $\hat{\beta}_t(\rho,\alpha)$, $\hat{\alpha}_t(\rho,\beta)$ and $\hat{\sigma}_t^2(\rho,\alpha,\beta)$ depend of ρ and that the Equation $\frac{\partial}{\partial\rho}\mathcal{L}_t = 0$ give complex results:

$$\frac{\partial}{\partial\rho}\mathcal{L}_t = \sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\frac{1}{\mid I_n-\rho W_\tau\mid}\frac{\partial}{\partial\rho}\mid I_n-\rho W_\tau\mid - \frac{1}{\sigma^2}\sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\sum_{i=1}^{n} e_{i\tau}\frac{\partial e_{i\tau}}{\partial\rho} = 0 \tag{C.22}$$

$$\Leftrightarrow \quad -\sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\frac{1}{\mid I_n-\rho W_\tau\mid}\mathrm{tr}\left(\mathrm{comt}\left[I_n-\rho W_\tau\right]\times W_\tau\right) = \frac{1}{\sigma^2}\sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\sum_{i=1}^{n} e_{i\tau}\left(-\left[W_\tau y_\tau\right]_i + \left[W_\tau\right]_i\alpha\right) \tag{C.23}$$

We have used that $\frac{d}{dx} \mid A(x) \mid = \mathrm{tr}\left(\mathrm{comt}\left[A(x)\right]\times\frac{d}{dx}A(x)\right)$ with $\mathrm{comt}\left[A(x)\right] = \mathrm{com}\left[A(x)\right]^T = \mathrm{com}\left[A(x)^T\right] = \mathrm{adj}[A(x)]$ and $\mathrm{com}(A(x))$ is the comatrix (or the cofactor matrix) of $A(x)$ and $\mathrm{adj}[A(x)]$ is the adjugate of $A(x)$. In particular, if $A(x)$ is invertible, we have $\frac{d}{dx} \mid A(x) \mid = \mid A(x) \mid \times\mathrm{tr}\left(A(x)^{-1}\times\frac{d}{dx}A(x)\right)$

$$\Leftrightarrow \quad \sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\mathrm{tr}\left(\left[I_n-\rho W_\tau\right]^{-1}\times W_\tau\right) = \frac{1}{\sigma^2}\sum_{\tau=t-b}^{t+b} K_{h,t}(\tau)\sum_{i=1}^{n} e_{i\tau}\left(\left[W_\tau y_\tau\right]_i - \left[W_\tau\right]_i\alpha\right) \tag{C.24}$$

Isolate ρ is very complex and this equation is not simpler to solve that the Equation C.12.

$$a_1^t(\rho)\alpha = a_2^t(\rho) - \underbrace{\sum_{\tau=t-b}^{t+b} K_{h,t}(\tau) \sum_{i=1}^{n} \left[(I_n - \rho W_\tau)\, X_\tau \left(\sum_{\tau'=t-b}^{t+b} K_{h,t}(\tau') \left[\left(X_{\tau'}^T X_{\tau'} \right)^{-1} X_{\tau'}^T (I_n - \rho W_{\tau'}) y_{\tau'} \right] \right) \right]_i}_{a_3^t(\rho)}$$

$$+ \underbrace{\sum_{\tau=t-b}^{t+b} K_{h,t}(\tau) \sum_{i=1}^{n} \left[(I_n - \rho W_\tau)\, X_\tau \left(\sum_{\tau'=t-b}^{t+b} K_{h,t}(\tau') \left[\left(X_{\tau'}^T X_{\tau'} \right)^{-1} X_{\tau'}^T (I_n - \rho W_{\tau'}) \mathbf{1}_n \right] \right) \right]_i}_{a_3^t(\rho)} \alpha \tag{C.26}$$

$$\Leftrightarrow \quad \hat{\alpha}_t(\rho) = \frac{a_2^t(\rho) - a_3^t(\rho)}{a_1^t(\rho) - a_4^t(\rho)}. \tag{C.27}$$

Given this function only depending of ρ, we can rewrite the ML problem given by Equation C.12 in using a 1-dimensional function $\mathcal{L}_t(\rho)$, which is defined thanks to the 4-dimensional log-likelihood function of Equation C.13:

$$\mathcal{L}_t(\rho) = \mathcal{L}_t\left(\rho, \hat{\beta}_t\big[\rho, \hat{\alpha}_t(\rho)\big], \hat{\alpha}_t\big[\rho\big], \hat{\sigma}_t\big[\rho, \hat{\alpha}_t(\rho), \hat{\beta}_t(\rho, \hat{\alpha}_t(\rho))\big] \right) \tag{C.28}$$

The ML problem to solve is hence $\hat{\rho}_t = \arg\max_\rho \mathcal{L}_t(\rho)$.

C.5.3 Bandwidth and cross-validation

The optimal bandwidth is hence the result of a well-known trade-off between the bias and the variance, that is determined by a cross-validation process. Cross-validation, also called out-of-sample testing, is a popular data-driven class of method to gauge model's predictive performance (Frydman et al., 1985; Fryzlewicz et al., 2008). The optimal bandwidth is the value h that minimizes the following cross-validation function:[13]

$$\hat{h} = \underset{h}{\operatorname{argmin}}\, CV(h) \quad \text{where} \quad CV(h) = \frac{1}{(T-1-h)n} \sum_{t=1+h/2}^{T-h/2} \sum_{i=1}^{n} \left(y_{it} - \hat{y}_{it}^{-t}(h) \right)^2 \tag{C.29}$$

[13] Alternative cross-validation specifications, computed with the sum of likelihood functions, have been tested and exhibit similar results.

Table C.3: Cross-validation process in order to determine the optimal bandwidth (which is defined as $h = 2b + 1$).

SET I								
b	1	2	3	4	5	6	7	8
$CV_{\mu}^{\hat{y}-y}$	**112.893**	112.896	112.908	112.926	112.945	112.964	112.981	112.998
CV_{μ}^{l}	**-106.698**	-106.713	-106.736	-106.762	-106.789	-106.814	-106.838	-106.895
$CV_{Med}^{\hat{y}-y}$	97.294	**97.290**	97.305	97.318	97.341	97.363	97.382	97.391
CV_{Med}^{l}	**-107.951**	-107.970	-107.971	-107.981	-107.994	-108.017	-108.020	-108.022
SET II								
b	1	2	3	4	5	6	7	8
$CV_{\mu}^{\hat{y}-y}$	93.6382	**93.6380**	93.650	93.666	93.683	93.700	93.714	93.728
CV_{μ}^{l}	**-121.774**	-121.785	-121.800	-121.817	-121.834	-121.850	-121.864	-121.877
$CV_{Med}^{\hat{y}-y}$	**84.757**	84.761	84.765	84.797	84.783	84.814	84.804	84.816
CV_{Med}^{l}	**-124.200**	-124.201	-124.203	-124.228	-124.257	-124.260	-124.284	-124.285
SET III								
b	1	2	3	4	5	6	7	8
$CV_{\mu}^{\hat{y}-y}$	83.114	**83.105**	83.106	83.111	83.122	83.134	83.144	83.155
CV_{μ}^{l}	**-140.134**	-140.142	-140.157	-140.175	-140.195	-140.214	-140.231	-140.247
$CV_{Med}^{\hat{y}-y}$	74.262	74.258	74.254	74.252	**74.251**	74.252	74.254	74.258
CV_{Med}^{l}	-143.444	-143.439	**-143.435**	-143.454	-143.529	-143.528	-143.527	-143.526
SET IV								
b	1	2	3	4	5	6	7	8
$CV_{\mu}^{\hat{y}-y}$	151.608	**151.604**	151.615	151.634	151.658	151.678	151.695	151.709

CV_{μ}^{l}	**-169.130**	-169.137	-169.392	-169.174	-169.199	-169.227	-169.256	-169.284
$CV_{Med}^{\hat{y}-y}$	63.432	63.411	63.392	63.373	63.355	63.336	63.318	**63.302**
CV_{Med}^{l}	**-164.711**	-164.725	-164.720	-164.715	-164.712	-164.743	-164.742	-164.770
SET V								
b	1	2	3	4	5	6	7	8
$CV_{\mu}^{\hat{y}-y}$	111.520	111.5130	111.5130	111.5096	**111.5081**	111.5104	111.5146	111.5579
CV_{μ}^{l}	-218.891	**-218.784**	-218.864	-218.968	-219.081	-219.202	-219.316	-219.424
$CV_{Med}^{\hat{y}-y}$	55.361	55.3595	55.3593	55.3581	55.3641	55.3550	**55.3538**	55.3622
CV_{Med}^{l}	**-209.5656**	-209.5657	-209.5663	-209.6174	-209.6185	-209.6203	-209.6231	-209.6311
SET VI								
b	1	2	3	4	5	6	7	8
$CV_{\mu}^{\hat{y}-y}$	**103.879**	103.907	103.940	103.971	104.003	104.039	104.076	104.112
CV_{μ}^{l}	-238.6158	**-238.5148**	-238.6077	-238.7257	-238.8497	-238.9823	-239.1070	-239.2154
$CV_{Med}^{\hat{y}-y}$	**52.6519**	52.6596	52.6687	52.6836	52.7007	52.7163	52.7321	52.7492
CV_{Med}^{l}	**-228.4998**	-228.5063	-228.5134	-228.5238	-228.5369	-228.5629	-228.5727	-228.584
SET VII								
b	1	2	3	4	5	6	7	8
$CV_{\mu}^{\hat{y}-y}$	56.2187	56.2153	56.2124	56.2105	**56.2101**	56.2105	56.2117	56.2133
CV_{μ}^{l}	**-260.7717**	-260.7926	-260.8103	-260.8243	-260.8467	-260.8791	-260.9124	-260.9441
$CV_{Med}^{\hat{y}-y}$	**48.6382**	48.6383	48.6450	48.6526	48.6638	48.6767	48.6711	48.6626
CV_{Med}^{l}	**-259.4646**	-259.4651	-259.4657	-259.4871	-259.4961	-259.5105	-259.5181	-259.5266

where $\hat{y}_{it}^{-t}(h)$ is a "leave-one-out" estimate of y_{it}, meaning that the estimate of y_{it} does not take into account the observation at time t.[14]

C.6 Robustness analysis

This section present some results of the robustness checks performed to assess the resilience of the core results and the main interpretations discussed in Subsection 4.3.1. In Subsection C.6.1, we introduce the SDSR estimation procedure and compare the results obtained with the method with those obtained by the LKSR estimation procedure. Subsequently, we briefly discuss and provide some results of simulations using alternative specifications for the spatial weighting matrix or different metaparameters (the different bandwidths and kernels).

C.6.1 SDSR estimation procedure

In order to test and compare the LKSR estimation procedure, we introduce a recent estimation strategy based on the Generalized Autoregressive Score-driven framework (Creal et al., 2011, 2013; Harvey, 2013).[15] This method is called the score-driven spatial regression (SDSR) and is based on Blasques et al. (2016b) and Catania and Billé (2017). It exploits the scaled score of the conditional density p_e to drive the time-variation in ρ_t, α_t, and σ_t^2 with an updating equation.

Figure C-3 exhibits the simulation results using the LKSR and SDSR estimation procedures for the baseline sample. Overall, we observe a strong similarity between the trends. In both cases, the intensity of international monetary spillovers massively rose during the 1980s and have very high values since 1990 ($\hat{\rho}_t \approx 0.65$). The sensitivity also follows the same pattern, with a large increase between the early 1980s and early 1990s (the peak is higher and came later based on the SDSR estimates) followed by a large drop

[14] In other words, this estimate is based on information of periods $\tau \in \{t-h/2, \ldots, t-1, t+1, \ldots, t+h/2\}$.

[15] See www.gasmodel.com for an attempt of exhaustive compilation of papers on the Generalized Autoregressive Score-driven framework.

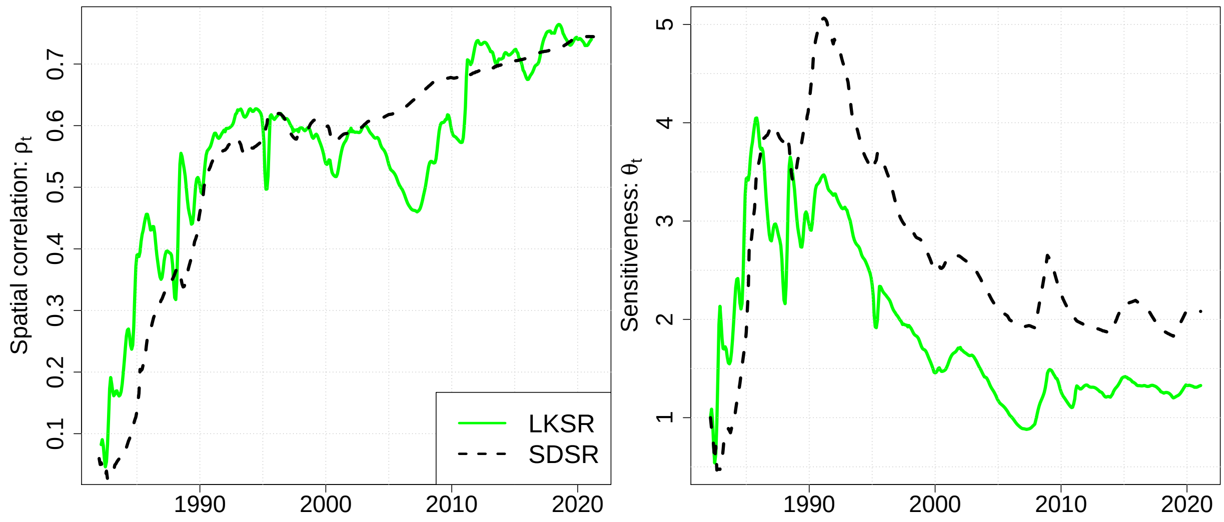


Figure C-3: LKSR vs. SDSR estimates - baseline scenario

For each panel, green lines (black dotted lines) report estimated parameters of LKSR (SDSR) processes. The left-hand panel shows the estimations of the spatial dependence parameters $\hat{\rho}_t$. The right-hand panel displays the estimates of the sensitivity $\hat{\theta}_t$.

and a stabilization after the GFC (as for the estimates based on the LKSR procedure). A difference between the two estimates is the absence of the decrease in the intensity of the spillovers in the 2000s for the SDSR estimates. Based on our tests, this may be due to the difficulty of the Score-Driven approach to capture such drops.[16] The similarity between these results confirm the robustness of our empirical conclusions.

The score-driven framework and the SDSR method As above-mentioned, the method uses the scaled score of the conditional density p_e to drive the time-variation in ρ_t, α_t, and σ_t^2. Based on Blasques et al. (2016b) and Catania and Billé (2017), the updating equation determining the dynamics of ρ_t, α_t, β_t and σ_t^2 in Equation 4.2 are given

[16]See subsequent paragraphs and Blasques et al. (2016b) for details.

by

$$\rho_t = h^{\rho}\left(\tilde{\rho}_t\right), \qquad \tilde{\rho}_t = \omega^{\rho} + A^{\rho} s^{\rho}_{t-1} + B^{\rho}\tilde{\rho}_{t-1} \tag{C.30}$$

$$\alpha_t = h^{\alpha}\left(\tilde{\alpha}_t\right), \qquad \tilde{\alpha}_t = \omega^{\alpha} + A^{\alpha} s^{\alpha}_{t-1} + B^{\alpha}\tilde{\alpha}_{t-1} \tag{C.31}$$

$$\beta_t = h^{\beta}\left(\tilde{\beta}_t\right), \qquad \tilde{\beta}_t = \omega^{\beta} + A^{\beta} s^{\beta}_{t-1} + B^{\beta}\tilde{\beta}_{t-1} \tag{C.32}$$

$$\sigma^2_t = h^{\sigma}\left(\tilde{\sigma}_t\right), \qquad \tilde{\sigma}_t = \omega^{\sigma} + A^{\sigma} s^{\sigma}_{t-1} + B^{\sigma}\tilde{\sigma}_{t-1} \tag{C.33}$$

where $\kappa = \{\tilde{\rho}_0, \omega^{\rho}, A^{\rho}, B^{\rho}, \tilde{\alpha}_0, \omega^{\alpha}, A^{\alpha}, B^{\alpha}, \tilde{\beta}_0, \omega^{\beta}, A^{\beta}, B^{\beta}, \tilde{\sigma}_0, \omega^{\sigma}, A^{\sigma}, B^{\sigma}\}$ are fixed unknown parameters, and $s^{\rho}_t = S_t(\tilde{\rho}_t)\nabla^{\rho}_t$ is the scaled score function (idem for α_t, β_t and σ^2_t). The scaled score function of $\tilde{\rho}$ is defined as the multiplication of a local scaling factor $S_t(\tilde{\rho}_t)$ (so depending of $\tilde{\rho}_t$) by the first derivative of the predictive log-likelihood function at time t with respect to $\tilde{\rho}_t$, noted $\nabla^{\rho}_t \equiv \left(\frac{\partial l_t}{\partial \tilde{\rho}_t}\right) = \left(\frac{\partial l_t}{\partial \rho_t}\right) \cdot \left(\frac{\partial \rho_t}{\partial \tilde{\rho}_t}\right)$, where

$$l_t(\kappa) \equiv \log p\left(y_t \mid \kappa\right) = \log p_e(y_t - \rho_t W_t y_t - Z_t^{-1}\alpha_t \mathbf{1}_n - X_t\beta_t, \sigma^2_t I_n; \lambda) + \log \mid I_n - \rho_t W \mid \tag{C.34}$$

For the sake of simplicity, through this robustness analysis, we use unit scaling, namely that $S_t(\tilde{\rho}_t) \equiv 1$, such that $s^{\rho}_t = \nabla^{\rho}_t$ (idem for α_t, β_t and σ^2_t). In order to estimate $\hat{\kappa}$ we use a ML procedure such that $\hat{\kappa} = \arg\max_{\kappa} L(\kappa)$ where $L(\kappa) = \sum_{t=1}^{T} l_t(\kappa)$.

Comparison via Monte Carlo simulations The two frameworks aforementioned share their own pros and cons, that are reported in Table C.4. To assess the performance of the two time-varying spatial estimates in filtering out different dynamic patterns for the spatial dependence parameter, we conduct a simulation study. The pattern of this experiment is similar to and inspired from the ones in Engle (2002) and Blasques et al. (2016b). In addition, we tested more sophisticated configuration with different structural changes. In this subsection, we summarize main results based on simulations.

The two estimation procedures capture accurately the general patterns of the simulated DGPs for the spatial correlation parameter ρ_t. Yet both estimation procedures perform better in presence of strong cross-sectional correlation. For each path, the esti-

	Score-Driven Spatial Regression	Local Kernel Spatial Regression
# parameters	12 p., high parsimony	4 p. $\times$ T, low parsimony
optimization complexity	very high, impossibility to assert global maximum	low, locally optimal
error sources	convergence issues outliers (global consequences) oversmoothing structural changes	overfitting (if h too small) outliers (local consequences)
inference	by iterations (Blasques et al., 2016a)	complex

Table C.4: Comparison between Local Kernel and Score-Driven Spatial Regressions

mate $\hat{\rho}_t$ is systematically very close to the real value ρ_t when this latter takes on high values ($\rho_t \approx 0.8$) relative to periods where real value ρ_t takes on small values ($\rho_t \approx 0.2$). In other words, the estimation variance of $\hat{\rho}_t$, $\sigma^2_{\hat{\rho},t}$ is inversely proportional to the value of spatial correlation ρ_t itself. More intuitively, the signal present in strongly cross-sectionally correlated data y_t is much more apparent than that in weakly correlated data.

However, the score-driven approach (SDSR) is subject to two additional over-smoothing issues. First, the SDSR tends to over-smooth when frequency changes: if the frequency of ρ_t varies over different subsamples, its estimation is biased and lead to over-smoothing high-frequency changes. This is directly related to the stability of $\hat{\kappa}$ over the entire sample (See Equation C.30 to Equation C.33). Second, the SDSR is subject to temporal asymmetry: as the data-driven process is based on autoregressive functions, the estimates of $\hat{\rho}_t$ are forward-looking in time, leading to some biases and transition periods in the presence of abrupt changes of ρ_t.

Another relevant difference between these two estimation procedures is their degree of complexity. The SDSR requires solving a complex non-linear numeric optimization problem whereas the local kernel (LKSR) relies on a simple local estimation problem. As a consequence, solving the ML optimization problem of the SDSR (Equation C.34) may lead to a local maximum, and consequently to incorrect estimations. Conversely, as the LKSR imposes a large number of parameters, it is more accurate. However, as it is unparsimonious, it can lead to data overfitting over a short horizon.

Based on a large set a simulation scenario, according to mean-squared errors and visual comparisons, the Local Kernel spatial regression seams more robust and tends to outperform the score-driven procedure in signal reconstruction.

Comparison on real datasets Our main results for the comparison on real data between the two estimation procedures are reported in Figures C-3, C-4, C-5, C-6, C-7, C-8, and C-9, one figure for one sample, from Set 1 to Set 7. The left-hand panels display the values of the estimated spatial dependence parameter ρ_t, which captures the intensity of responses to international monetary policy spillovers, for the two time-varying spatial regression procedures, LKSR and SDSR. The right-hand panels present the time-varying sensitivity estimates $\hat{\theta}_t$.[17]

The values taken by $\hat{\rho}_t$ follow the same trend for the two estimation procedures. It evolves from 0.1/0.2 in 1982, increase to around 0.6 in around 1995 to take values around 0.7 in the 2010s. As aforementioned on the comparison via Monte Carlo simulations, we notice that the pattern taken by $\hat{\rho}_t$ for the Score-Driven Spatial approach is smoother, relative to the local kernel estimation, which indicates that the LKSR approach slightly over-fit or that the SDSR approach over-smooth the trends. Based on this view, the LKSR approach seems more appropriate to capture short-term dynamics in presence of structural changes of monetary policy rates, as in our case (notably, around the GFC). The two procedures reveal an increasing intensity of monetary policy response to monetary policy rate spillovers between the 1980s and the 2010s. However, the local kernel estimation captures three salient periods: a large increase in the 1980s and early 1990s, a decrease between mid-1990 and the GFC, and finally a second rise in the intensity of monetary policy spillovers after the GFC. During the decreasing period of $\hat{\rho}_t$, s_t is increasing, meaning that the trend toward more economic integration is not always associated with an increasing sensitivity to international monetary policy spillovers; $\hat{\theta}_t$ decrease during that period.

Importantly, the estimates $\hat{\rho}_t$ with the SDSR approach do not exhibit this three stage

[17]The results of the estimations for α_t and σ_t are available upon request. The values of $\hat{s}_t$ are the same because the spatial weighting matrices used are the same.

pattern. Rather, the intensity of international monetary policy spillovers seem smoother, increase continuously and almost monotonically. Two points have to be added about this observations. First, relative to the results based on the LKSR estimation procedure, results with the SDSR approach are less consistent between the different samples. For example, we see a large drop of $\hat{\rho}_t$ for Set 4 in 2000, but nothing for Set 3, and the shock is much smoother for Set 5. Second, even if we do not observe a clear three-stage pattern with the SDSR estimation procedure and that the intensity of monetary policy spillovers seem to increase more monotonically, the speeds of the rises evolve over time. A key impact is that, for all of the estimations, the two procedures reveal an increasing sensitivity of monetary policy response to monetary policy rate spillovers in the 1980s, a decrease trend after the early 1990s and a stabilization around a trend after the GFC. Therefore, our indicator of monetary policy sensitivity to peers, $\hat{\theta}_t$, seem even more robust than the estimation of the intensity of monetary spillovers, $\hat{\rho}_t$.

Regarding the time-varying standard deviation, $\hat{\sigma}_t$ and common trend, or intercept, $\hat{\alpha}_t$, both methods are able to capture the common factor and the standard deviation of monetary policy interest rates over our sample and give very close estimations.

Overall, the results of the empirical strategies highlight the strength of the response to monetary policy rates of neighboring economies, as measured by the parameter ρ_t. It indicates that monetary policy rates are positively affected by international policy rates and also suggests that monetary areas have partially lost their monetary policy autonomy through trade connections. The core results of Subsection 4.3.1 and our main conclusions seem robust to changes in the estimation procedure.

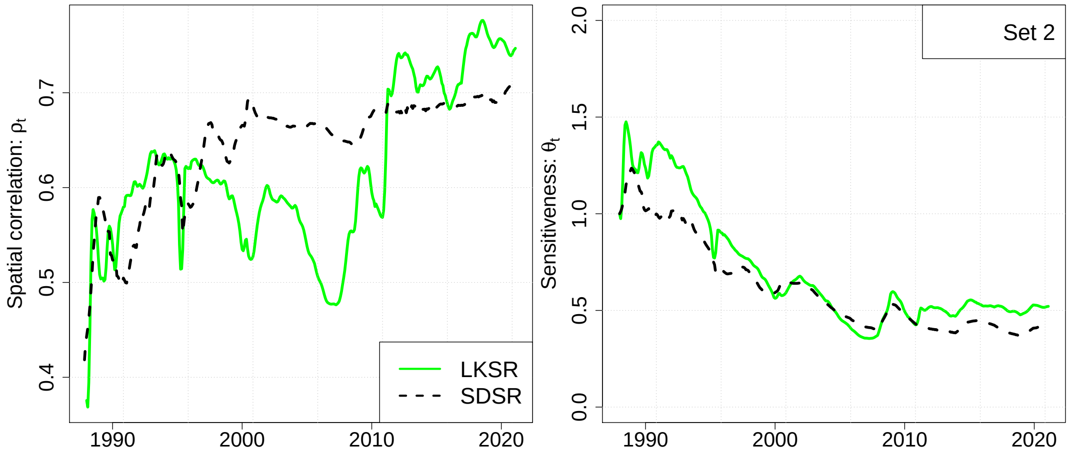


Figure C-4: LKSR vs. SDSR estimates - Set 2

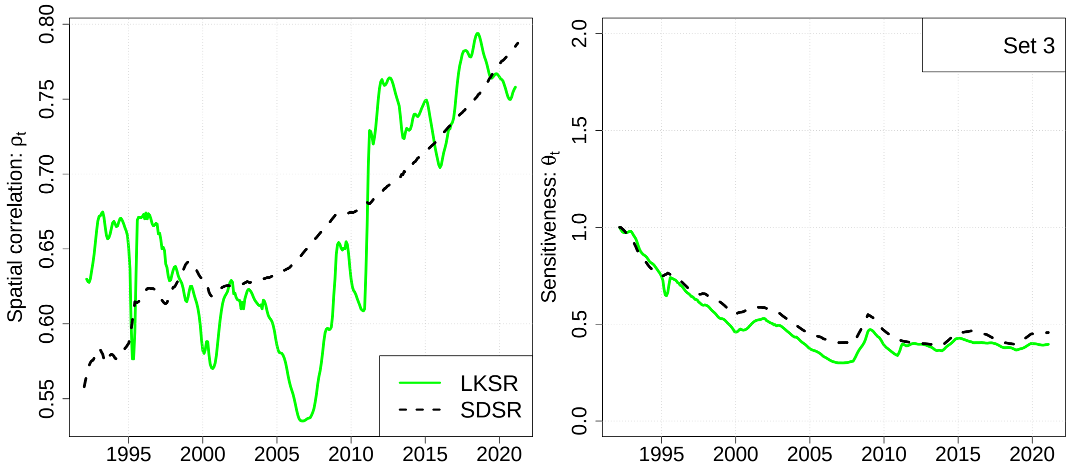


Figure C-5: LKSR vs. SDSR estimates - Set 3

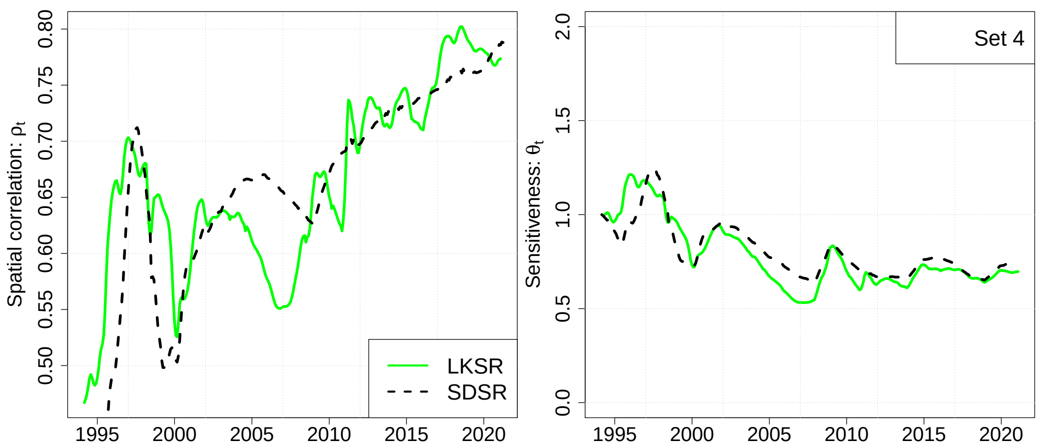


Figure C-6: LKSR vs. SDSR estimates - Set 4

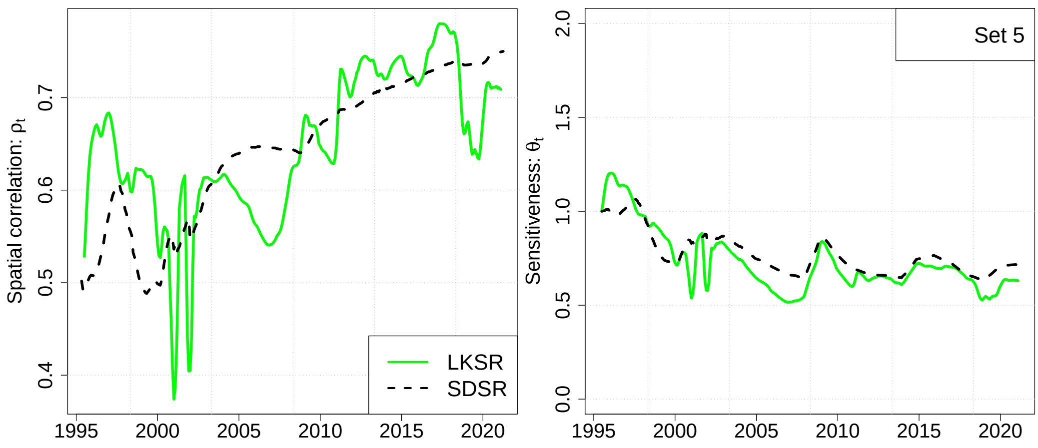


Figure C-7: LKSR vs. SDSR estimates - Set 5

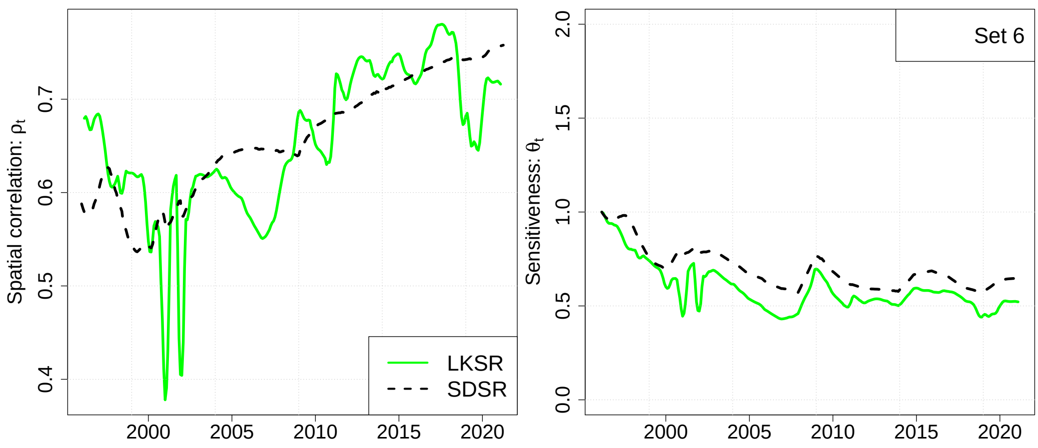


Figure C-8: LKSR vs. SDSR estimates - Set 6

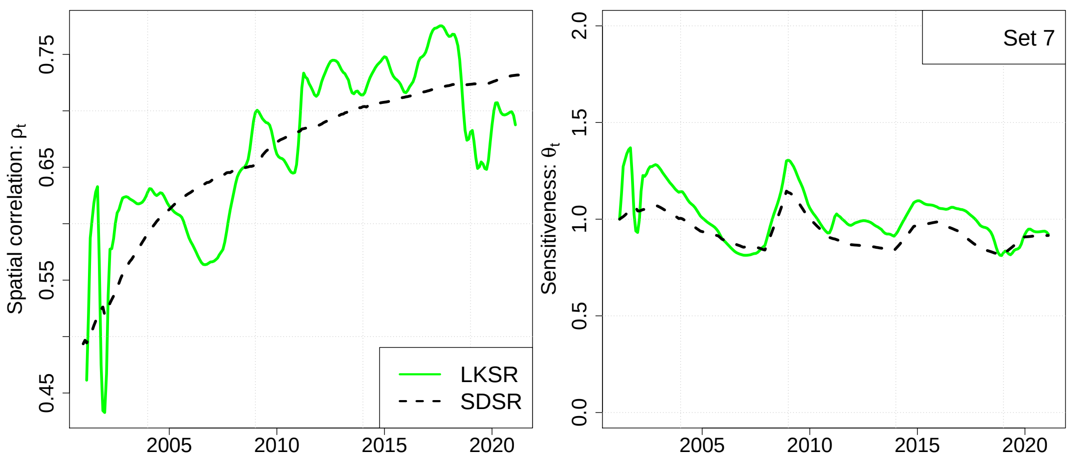


Figure C-9: LKSR vs. SDSR estimates - Set 7

C.6.2 Alternative matrices and metaparameters

This section reports some results relative to simulations based the LKSR estimation procedure but with alternative specifications for the spatial weighting matrix or specific metaparameters.

Alternative matrices In the core results, the transmission channel matrix is elaborated thanks to the UN Comtrade dataset, following the arguments provided in Subsection 4.2.4. To examine the robustness of the estimates obtained using this spatial weighting matrix it is useful to test whether or not the international trade weighting matrix is a better spatial weighting matrix to capture spillovers dynamics compared to other measures of distance as well as whether or not a change in the spatial weighting matrix alter the estimates $\hat{\rho}_t$. A comparison of log-likelihood values and a visual comparison of the estimates $\hat{\rho}_t$ indicate that the core results are robust.

Table C.5 reports the log-likelihood values (per country and per time period) for a few different matrices. These assessments support the hypothesis that trade connections are more suitable to capture monetary spillovers than geographic-based and FDI-based matrices; the values of L for W_t^{multi} are higher than those for W^{geo} and W_t^{FDI}. These results also corroborate the hypothesis that a time-varying trade matrix better fit the data than a constant trade matrix (composed of the mean values of the time-varying matrix); the values of L for W_t^{multi} are higher than those for W^{multi}. Similar simulation results than those based on the UN Comtrade dataset were found on the overlapped periods with an older trade-based NBER dataset covering a shorter sample. Yet our results also indicate that, as rationality would have suggested, financial flows could be a good measure of connections to capture international monetary policy spillovers. Indeed, matrices based on equity and debt liabilities and assets provide better log-likelihood values than the trade matrix. It is worth noting that these last results must be considered with prudence given the limiting amount and the quality of data for the estimates of the financial connections, in particular due to the small number of countries (only 12 in Table C.5 for W_t^{FDI}, W_t^{EqDe}

Set 1 (1982-2021)	Matrices	W_t^{multi}	W^{multi}	W^{geo}	
	Log-likelihood, $L/(nT)$	**-3.655651**	-3.657797	-3.666994	
Set 4 (1994-2021)	Matrices	W_t^{multi}	W^{multi}	W^{geo}	
	Log-likelihood, $L/(nT)$	**-3.651374**	-3.651535	-3.676856	
Set 7 (2001-2021)	Matrices	W_t^{multi}	W^{multi}	W^{geo}	
	Log-likelihood, $L/(nT)$	**-3.425268**	-3.429399	-3.451392	
Set KS (1989-2005)	Matrices	W_t^{multi}	W_t^{FDI}	W_t^{EqDe}	W_t^{totFF}
	Log-likelihood, $L/(nT)$	-4.191044	-4.194170	**-4.183638**	-4.184198
Set KS-ext. (1989-2021)	Matrices	W_t^{multi}	W_t^{FDI}	W_t^{EqDe}	W_t^{totFF}
	Log-likelihood, $L/(nT)$	-3.709527	-3.711460	**-3.686755**	-3.688886

Table C.5: Comparison between different spatial weighting matrices

Goodness of fit comparison between spatial weighting matrices are based on trade flows, financial flows or geographical distance connections. For each row, the largest log-likelihood value is made bold. L indicates the values of the log-likelihood function and is defined by $L \equiv \sum_{t=1}^{T} l_t = \sum_t l(\hat{\rho}, \hat{\alpha}, \hat{\sigma} \mid y_t, X_t, W_t)$. We normalized these values by the number of periods and countries in the sample for each simulations. Each row of results reports the values of the log-likelihood function for a similar sample (with the time span indicated in parentheses in the first column). W_t^{multi} is the main matrix used in the paper and is described in Subsection 4.2.4. It is a time-varying matrix based on international trade flows. W^{multi} is a constant version of W_t^{multi}, with $w_{ij}^{\text{multi}} = \frac{1}{T}\sum_{t=1}^{T} w_{ijt}^{\text{multi}}$ (time average). W^{geo} is a spatial weighting matrix based on geographic distance, considered here as the distance between the capitals of each country. Alternative measures of geographic distance were tested and the results indicate the same pattern (the likelihood is always higher for W_t^{multi}). For these three matrices, we provided the results for three samples (Sets 1, 4, and 7 - described in Table C.1) to give a broader perspective and enable to asses the impact of a change on the sample. Matrices W_t^{FDI}, W_t^{EqDe} and W_t^{totFF} are based on Kubelec and Sá dataset (Kubelec and Sá, 2012). The distance in W_t^{FDI} is based on the FDI between the two countries. Similarly, W_t^{EqDe} is based on the equity (Eq) and debt (De) assets and liabilities between countries. W_t^{totFF} includes the measures of FDI, equity and debt assets and liabilities between countries as well as the amount of reserve by central banks. Based on data availability, these matrices are compared with W^{multi} with only two small samples; Set KS and Set KS-extended. Both only include twelve monetary areas (Argentina, Australia, Brazil, Canada, India, Japan, South Korea, Mexico, Singapore, the UK, the UK and the Eurozone). The time span of Set KS is determined by the available data for interest rates (starts in 1989) and the financial measures provided by Kubelec and Sá (2012) (ending in 2005). Set KS-extended is the same sample that Set KS in terms of countries but extends the time span, considering a constant matrix between 2005 and 2021.

and W_t^{totFF}). Given this lack of data and the fact that there financial-based matrices do not clear outperform the trade-based matrix (the FDI-based matrix does not provide better log-likelihood values), international trade seems to be a good indicator of economic connections.

Importantly, based on available data, estimates $\hat{\rho}_t$ for different types of economic relationships (international trade flows, FDI flows, equity and debt assets and liabilities, etc.) suggest that the trends discussed above are robust to different measures of economic integration. Indeed, Figure C-10 exhibited some of the possible estimates. We

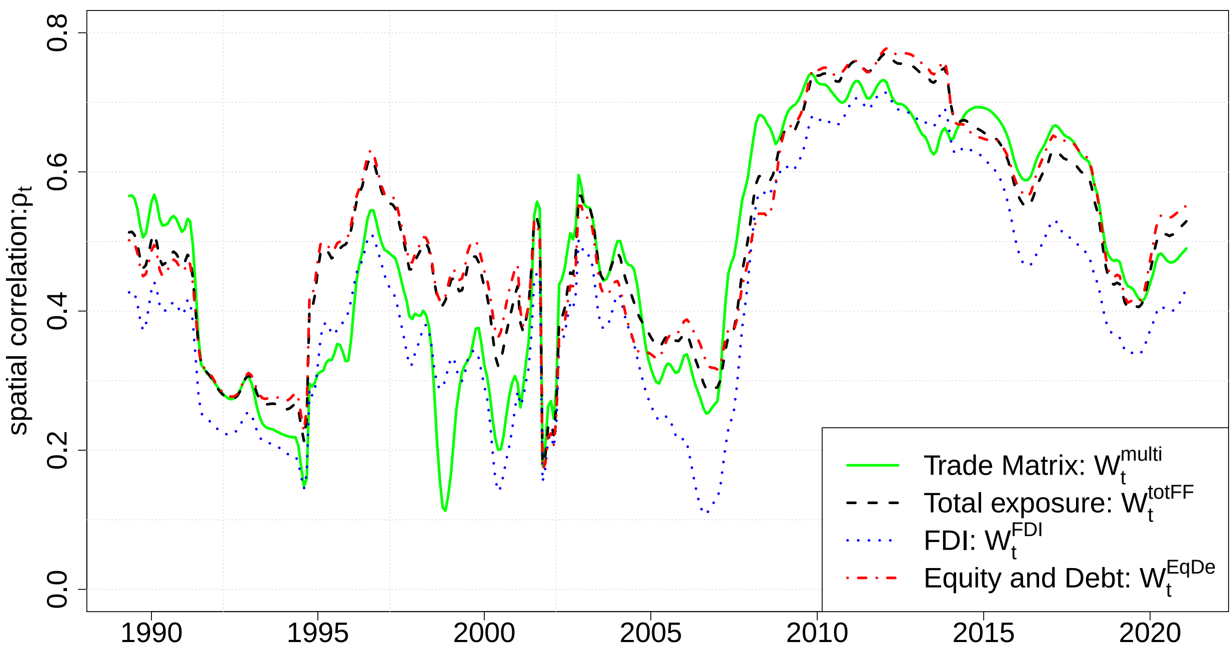


Figure C-10: Estimates $\hat{\rho}_t$ for different bandwidths

These estimates are based on Set KS, which includes only 12 countries (Argentina, Australia, Brazil, Canada, India, Japan, South Korea, Mexico, Singapore, the UK, the UK and the Eurozone). Values after 2005, are based on the simplification that financial-based matrices are constant (due to lack of data for the more recent periods). Matrices W_t^{FDI}, W_t^{EqDe} and W_t^{totFF} are based on Kubelec and Sá dataset (Kubelec and Sá, 2012). The distance in W_t^{FDI} is based on the FDI between the two countries. Similarly, W_t^{EqDe} is based on the equity (Eq) and debt (De) assets and liabilities between countries. W_t^{totFF} includes the measures of FDI, equity and debt assets and liabilities between countries as well as the amount of reserve by central banks.

observe that, even if differences exist, the values taken by $\hat{\rho}_t$ are close to each other, with similar trends, ups and downs. More specifically, this is highlighted in Table C.6 which displays the high level of correlation between the estimates $\hat{\rho}_t$ obtained based on the spatial weighting matrices W_t^{multi}, W_t^{FDI}, W_t^{EqDe} and W_t^{totFF}. This corroborates the two important hypotheses according to which (i) the core results for the intensity of the international monetary policy spillovers are robust to changes in specifications, even if we take other economic indicators of interconnections between monetary areas, and (ii) trade and financial globalization are highly interconnected and can be seen, as discussed above in subsection 4.2.4, as a common multifactorial phenomenon. Based on the high level of proximity between these trends of $\hat{\rho}_t$, this also suggests that it is more appropriate to use the term of economic integration in this paper, rather than trade and financial integration.

These two terms would have the drawback of claiming a possible disentanglement of the two largely overlapping and intertwined transformations. Again, these results should be considered with caution given the limited amount of data.

	W_t^{multi}	W_t^{totFF}	W_t^{FDI}	W_t^{EqDe}
W_t^{multi}	1.0000	0.9090	0.9323	0.8784
W_t^{totFF}	0.9090	1.0000	0.9757	0.9918
W_t^{FDI}	0.9323	0.9757	1.0000	0.9494
W_t^{EqDe}	0.8784	0.9918	0.9494	1.0000

Table C.6: Correlation between estimates $r\hat{h}o_t$ for different spatial weighting matrices

An important metaparameter in spatial regression is the number of nearest neighbors that are enabled to influence an entry, denoted k. This metaparameter acts as a measure of the degree of sparsity of the spatial weighting W_t. Implicitly, in the core of the paper, we consider that all countries can impact all others, such that $k = n$. Indeed, we regard every country as participating in the global monetary spillovers based on the trade connections. Yet we could also consider that weak links between peripheral countries do not represent a part of the interaction structure but are perturbations or idiosyncratic values which alter the estimation. To deal with this issue, a common method to re-weight the transmission channel matrix W_t consist to define a specific number of allowed connections by countries; that is, the number of nearest neighbor k. Above, we implicitly assumed that all countries are influenced by all others, meaning $k = n$. In an extreme scenario, $k = 1$ and the specification is then such that the approach is unipolar (in the sense defined in Section 4.4). We tested if variations of k affect the results and the results are exhibited in Figures C-11 and C-12. The second figure, exhibiting estimates $\hat{\rho}_t$ for different k, suggests that the estimations provided in the core of the paper for the intensity of international monetary policy spillovers, $\hat{\rho}_t$ are very robust to variations of this metaparameter. Even with very small values of k (for example, 2, 4, and 6 on the figure), the trend of $\hat{\rho}_t$ is similar and differences are small.

Because the number of nearest neighbors k is an indicator of the unipolarity of the spatial weighting matrix W_t, an alternative statistical test of the multipolar hypothesis

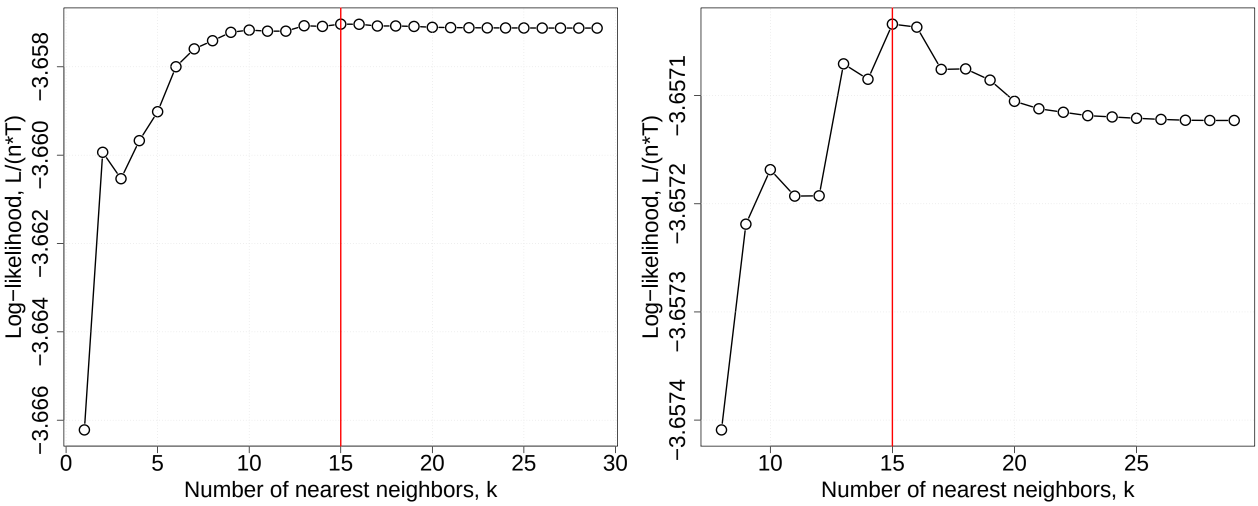


Figure C-11: Log-likelihood L for different numbers of nearest neighbors k

The sample used is the baseline sample (Set 1). The different between the left-handed and right-handed panels is the number of values of k that are exhibited (all possible values of k on the left; values of k above eight on the right). $k = 15$ is the number of nearest neighbors that maximize the log-likelihood function, indicating that around 15 major interactions affect international monetary policy and then confirming the multipolar hypothesis discussed in Section 4.4.

(defined and tested in Section 4.4) consists on performing a goodness of fit comparison via log-likelihood values $L = L(k)$. If L is higher for very low values of k than for high values, it indicates that only few economic interconnections are at the root of international monetary policy spillovers. Indeed, a modeling with $k = 1$ is close to the US unipolar modeling and the base-country unipolar modeling with W_t^{BC} defined in Appendix C.7.2.[18] Similarly, the case with $k = 4$ can be viewed as an alternative for W_t^{big4} where Fed, the ECB, the BoE and the BOJ are the four main monetary policy institutions that influence other monetary policies. Following this comparison, low values of L for lower values of k than around 5-10 would suggest that more than 5-10 interconnections play a important role on the development of international monetary policy spillovers and therefore would corroborate the multipolar hypothesis.

Figure C-11 display the values of the log-likelihood function L for different numbers

[18]Two differences are that (i) in the base country scenario we a priori define a reference country/monetary area for each country/monetary area based on historical monetary cooperation, close broad economic and political links, etc. while in the scenario with $k = 1$ only the values of W_t are used to defined a country of influence, and (ii) in the base country scenario, the US and the Eurozone are viewed are independent actors, which is not the case in the $k = 1$ model.

of nearest neighbors k. On the left-hand panel, we observe that the log-likelihood is fairly stable between $k = 10$ and $k = n = 29$ but considerably drop when k takes values lower than eight. This is in line with observations highlighted in Section 4.4 and Appendix C.7.2 and confirm the multipolar hypothesis. We also see that the model is slightly better when we add a certain degree of sparsity, with a rise of the log-likelihood when k decrease from 29 to 15. This corroborates the intuition that very small interconnections add noise to the signal more than impact the monetary spillovers. Yet Figure C-12 shows that the estimates $\hat{\rho}_t$ are not distinctly affected by changes of k in this range of values. Only when k is below 10 that we start observing visual differences.

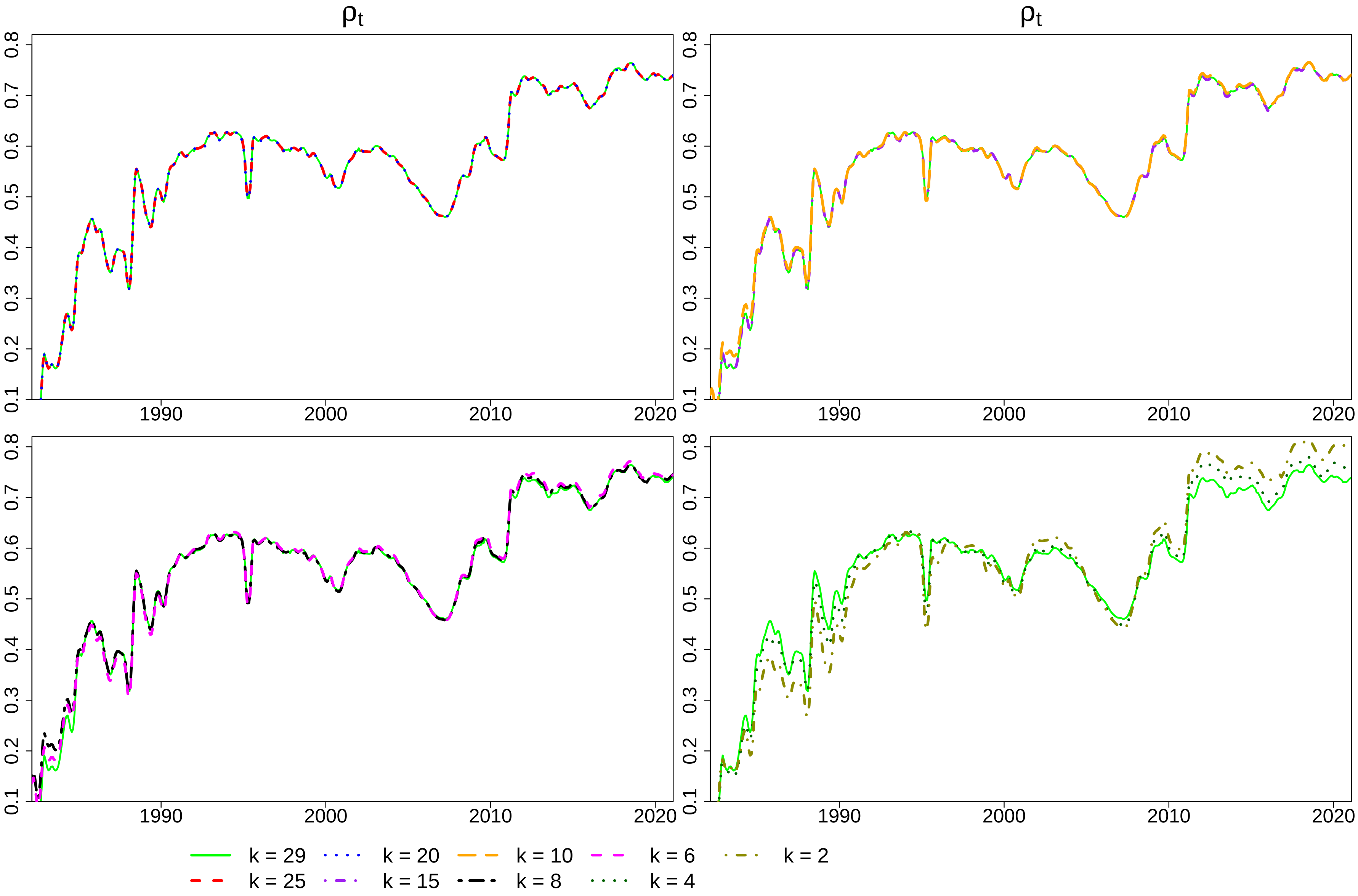


Figure C-12: Estimates $\hat{\rho}_t$ for different numbers of nearest neighbors k

Alternative metaparameters for LKSR The performance of LKSR estimations are influenced by window lengths and the shape of the kernel. As it depends less on the shape of the kernel K than on the value of its bandwidth h, we opted for a standard kernel shape, i.e. the Epanechnikov kernel. We tested three kind of kernel: (i) a uniform or constant kernel ($K(x) \propto I(|u| \leq 1)$); (ii) an Epanechnikov kernel ($K(x) \propto (1 - x^2)I(|u| \leq 1)$); and (iii) an Gaussian or Normal kernel ($K(x) \propto \exp(-x^2/2)$). Monte Carlo simulations and empirical results displays very similar results. For the sake of scarcity, we only report the estimation results with the Epanechnikov kernel in the core of the paper. For illustration purposes, Figure C-13 exhibits the estimates $\hat{\rho}_t$ for a Uniform and a Epanechnikov kernel using the same window length that in the core results of this paper. Even if the difference in shape between the Epanechnikov kernel and the uniform kernel is large than between the Epanechnikov kernel and the Gaussian or Normal kernel (or most kernel functions, such as a triangle, etc.), the estimates are extremely close to each other. This indicates that the core results are robust to changes of kernel functions.

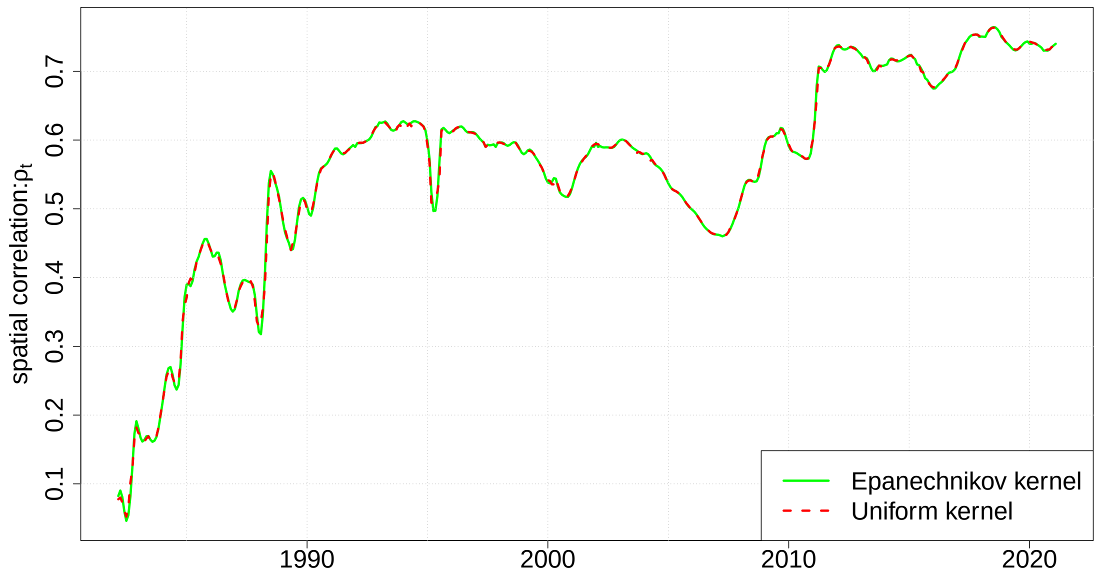


Figure C-13: Estimates $\hat{\rho}_t$ for baseline sample using uniform and Epanechnikov kernels

We developed an optimization procedure to select the most appropriate bandwidth based on a cross-validation procedure. The details on the procedure are provided in Appendix C.5.3. On the one hand, too small values of h lead to very spiky and volatile estimates for the spatial dependence parameter $\hat{\rho}_t$. On the other hand, too large values of h generate oversmoothing and lead to a lack of details about the trend of $\hat{\rho}_t$. More generally, both situation may results in large mean square errors (MSE).

Even if the cross-validation procedure is a data-driven strategy enabling us to rely on this technique to solve this issue, we would like to assess the influence of a change of h (and in the same time, the influence of an error in the selection by the cross-validation procedure). Figure C-14 displays the estimates $\hat{\rho}_t$ based on the LKSR procedure using different bandwidth for the baseline sample. We see clearly on the figure that the estimates are marginally affected by the bandwidth and that the empirical conclusions developed in the core of the paper hold for alternative bandwidths (and then alternative bandwidth selection techniques).

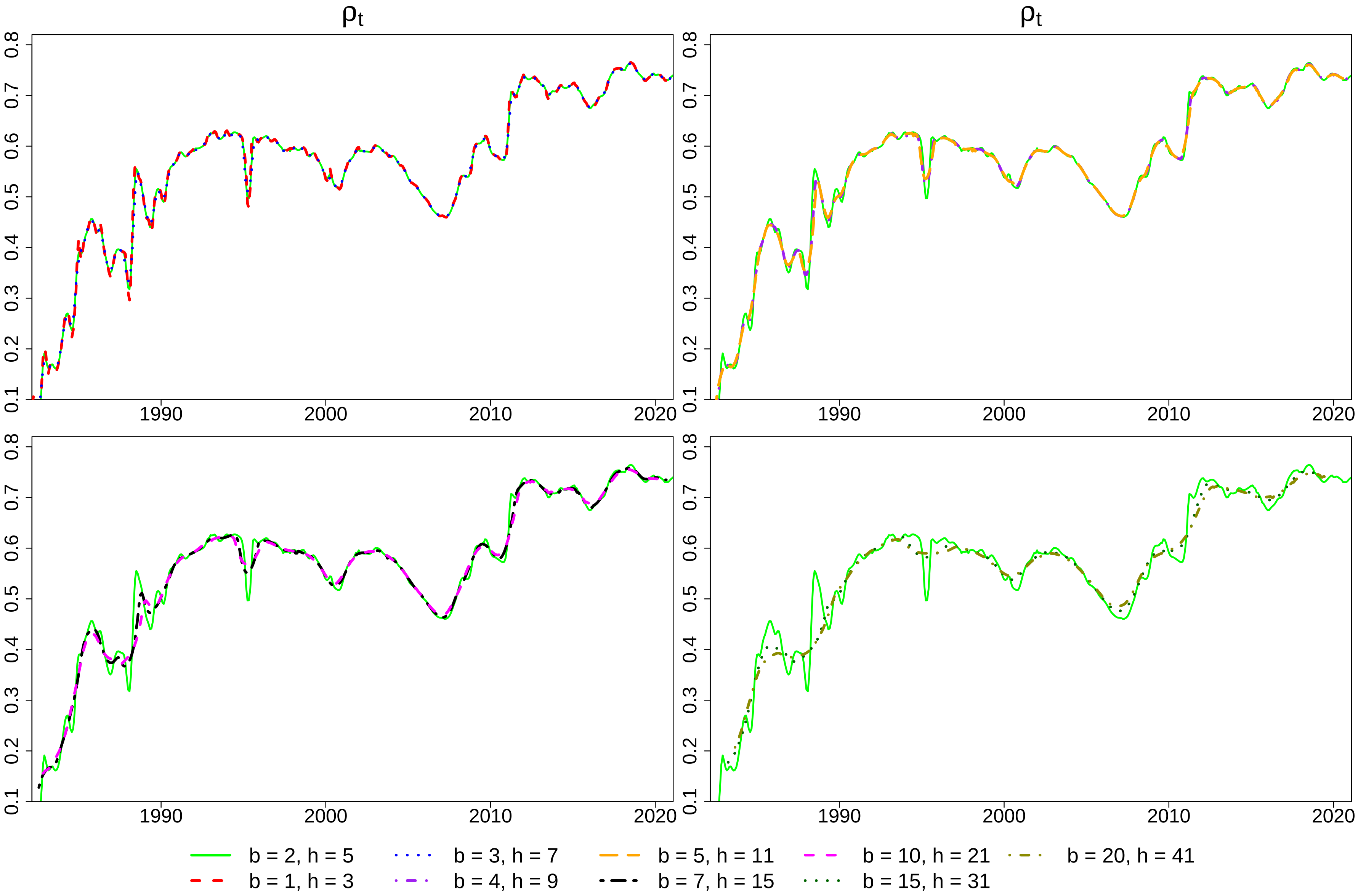


Figure C-14: Estimates $\hat{\rho}_t$ for different bandwidths

In these simulations, the bandwidth is defined such that $h = 2b + 1$.

C.7 Complements to the estimations with two matrices

C.7.1 Full period estimations of γ_t

Figure C-15

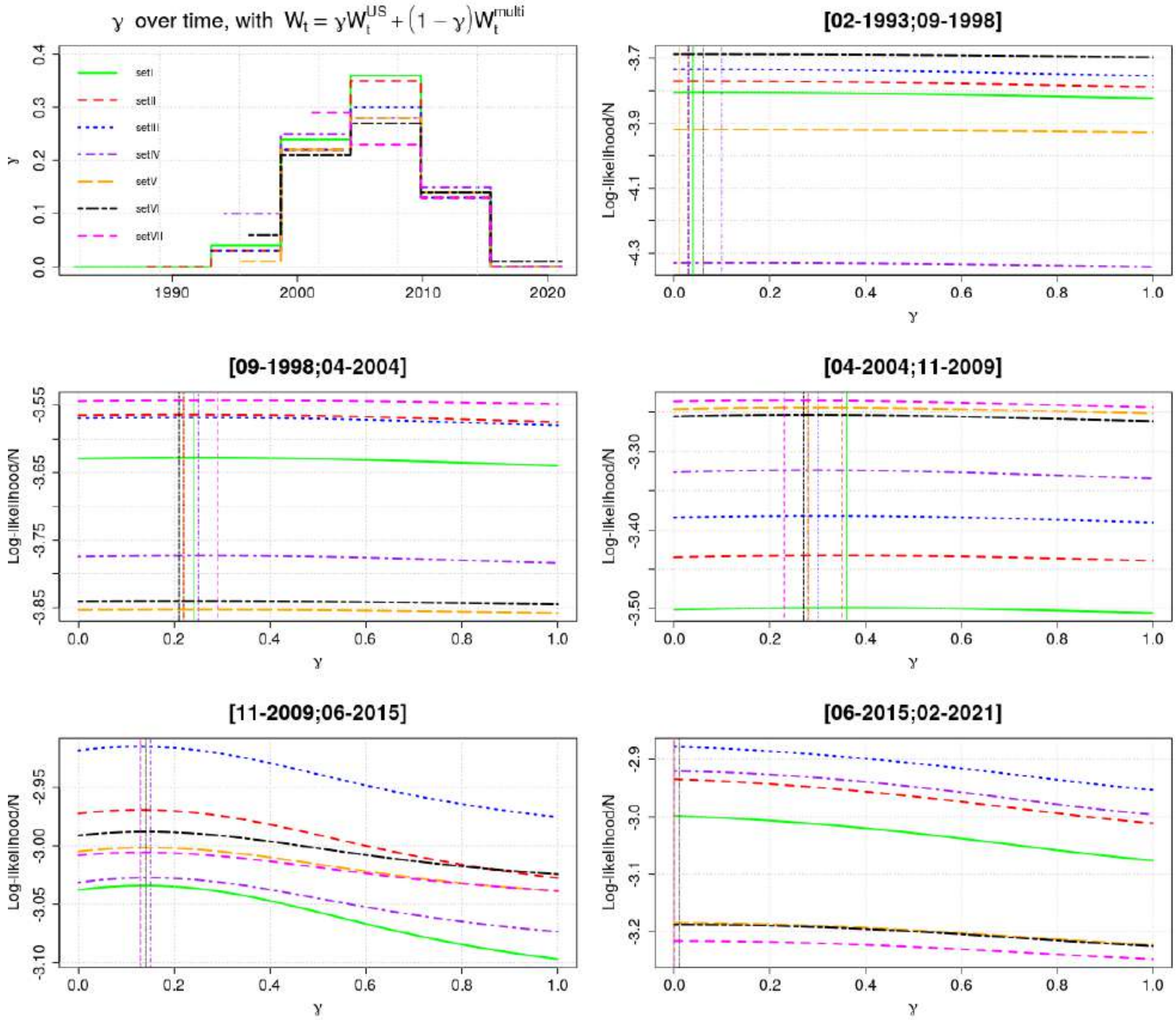


Figure C-15: Multipolar spillovers, a better estimation procedure.
Goodness of fit comparison via log-likelihood values $L(\gamma)$: from 1982 to 2021; $W_\gamma = \gamma W_{US} + (1-\gamma) W_{\text{trade}}$; increment of 0.01.

C.7.2 Alternative transmission channel matrices

In order to provide some additional evidence confirming the multipolar hypothesis and the increasing multipolarity of international monetary spillovers after 2008, we discuss here three additional models, based on Equation 4.6, hinged on the dominance of few major monetary actors (notably, the ECB and the Fed). The first is the base-country model discussed in the introduction of the section and schematized in Figure 4-6. It is the second common unipolar approach. In this scenario, we define a spatial weighting matrix W_t^{BC} in a similar way than for W_t^{US} except that the spillovers are not due to the US only but to a base country for each country in the samples. Often, the base country is the US or the EMU (see details on the list of base countries for all countries in Appendix C.1). A second scenario consists on considering the Fed, the ECB, the BoE and the BOJ as the four main monetary policy institutions that influence other monetary policies. Based on this view, we define W_t^{big4} as a multipolar but very sparse spatial weight matrix where only previously mentioned central banks influence the rest of the world. A last scenario is to suppose that core countries, in opposition to semi-periphery and periphery countries, influence the rest of the world. In this case, W_t^{core} is such that core countries' columns are equivalent to W_t^{multi} and other columns are full of zeros. W_t^{core} models multipolar but sparser transmission channel of monetary spillovers where richer countries influence the emerging and developing world. The list of core countries is given in Appendix C.1.

As an additional test of the multipolar hypothesis, we estimate the log-likelihood function $L(W_t) = \sum_{\forall t} l_t(\rho_t, \alpha_t, \sigma_t | y_t, W_t)$ with l_t defined by Equation 4.5 on the full samples using the LKSR estimation procedure (see Subsection 4.2.6) to estimate $\hat{\rho}_t$, $\hat{\alpha}_t$ and $\hat{\sigma}_t$ for each spatial weighting matrices introduced so far; from the most centered on the US to the most multipolar approach, we have W_t^{US}, W_t^{BC}, W_t^{big4}, W_t^{core} and W_t^{multi}. We also include two binary matrices with only values taking 0 or 1 for the US-centered and the base-country unipolar approaches, with their respective spatial weighting matrices noted $W_t^{\text{US,01}}$ and $W_t^{\text{BC,01}}$. Results for these simulations are displayed in Figure C-16 for each

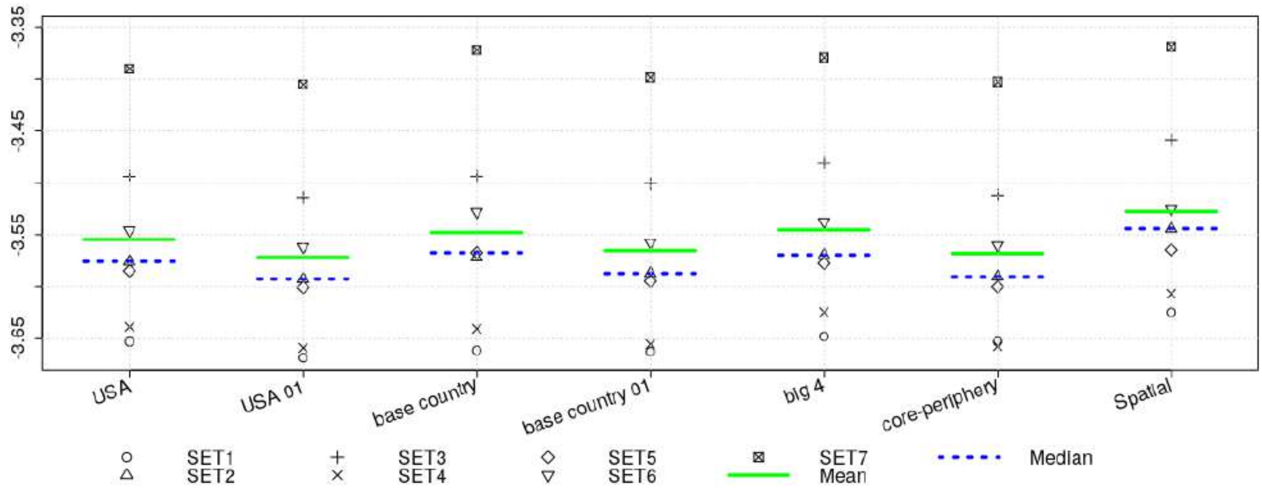


Figure C-16: Goodness of fit comparison between different alternative specifications. Goodness of fit comparison via log-likelihood values $L(W_t)$, with W_t respectively equals to W_t^{US}, $W_t^{\text{US,01}}$, W_t^{BC}, $W_t^{\text{BC,01}}$, W_t^{big4}, W_t^{core} and W_t^{multi}.

sample and each spatial weighting matrix. Means and medians are also exhibited in order to a quick idea of the trends. Few elements are noticeable. Firstly, we observe that the multipolar hypothesis is confirmed by the fact that $L(W_t^{\text{multi}}) > L(W_t^*)$ with W_t^* one of the alternative spatial weighting matrices. Secondly, binary matrices perform poorly relative to their trade-based equivalent.[19] Thirdly, results suggest that W_t^{BC} and W_t^{big4} are the two best alternative specifications, in particular for the last samples (sets 6 and 7). This indicates that the role of the ECB, the BoE and the BOJ was significant in recent periods core by these samples.

Some observations of the previous subsection suggest an increase in the influence of the US in the 2000s and a subsequent decline during the next decade. In other words, international monetary policy spillovers seems to have been increasing the product of multipolar transmission channels after the GFC. This raises the following questions: was it specific to the Fed? did other western central banks' influence rise and decline in a similar way? To address these questions, we perform the same identification strategy developed in the Subsections 4.4.1 and 4.4.2 to estimate the parameter γ_t for seven sub-periods using subsequently W_t^{BC}, W_t^{big4} and W_t^{core} as W_t^1. In all three cases, W_t^2 is the

[19]More binary matrices were tested and the results follow this pattern for these specifications.

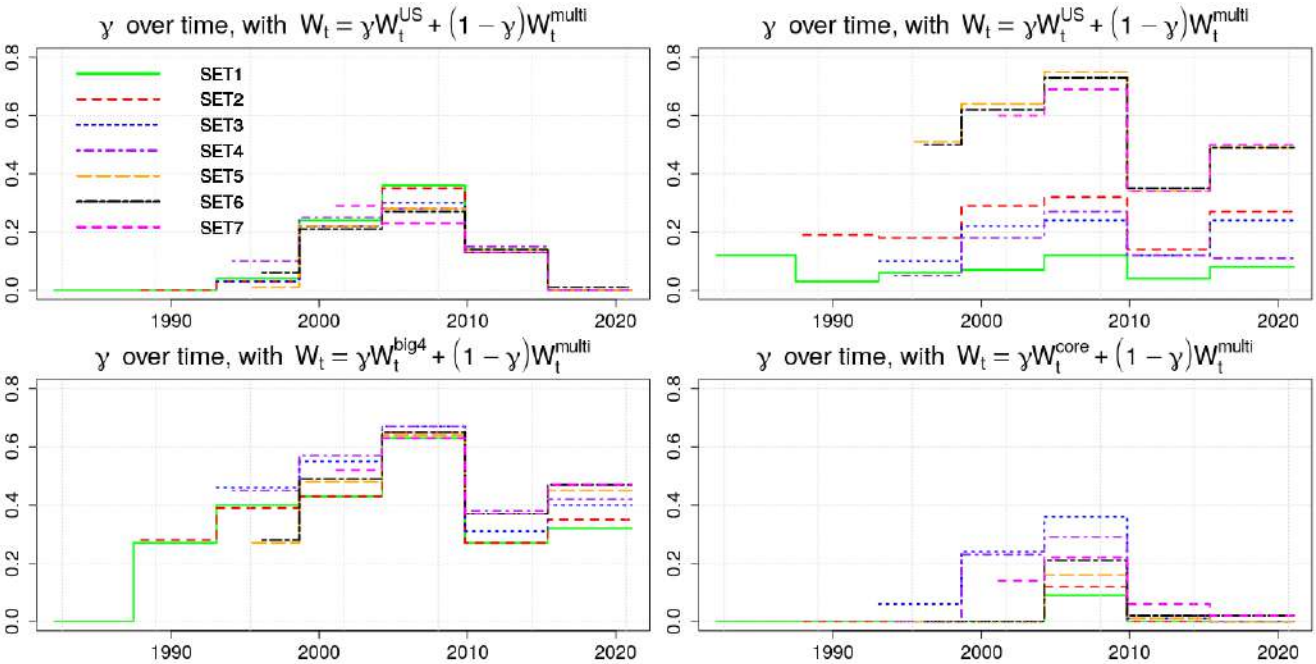


Figure C-17: Estimates $\hat{\gamma}_t$ for $W_t^1 = W_t^{\text{US}}$, $W_t^1 = W_t^{\text{BC}}$, $W_t^1 = W_t^{\text{big4}}$ and $W_t^1 = W_t^{\text{core}}$.

same and is W_t^{multi}.

Estimates $\hat{\gamma}_t$ for these main alternative specifications, each sunperiod and each samples are exhibited in Figure C-17. Several conclusions can be drawn. First and foremost, we see in each simulations an increase in the role of the key countries (the Fed, the ECB, and potentially other core countries) between the 1990s and the 2000s followed by a drop during the decade after. This confirms the hypothesis that the decade of the GFC was a period marked by the significance of Western and/or developed countries' monetary institutions in the development of international monetary spillovers. Importantly, in line with results in Figure C-16, we note that $\hat{\gamma}_t$ is on the whole higher in particular for W_t^{BC} and also W_t^{big4} relative to values obtained for W_t^{US} and W_t^{core}. This confirms that the ECB played a significant role as source of international monetary spillovers (especially for the last two decades). On the contrary, as a whole, core countries do not seem to have played a clear distinct role than others countries, except slightly during the period 1998-2010, and their influence appears to have been due to their economic connections and weights (such as measured by international trade).