Global liquidity cycles and exchange rate policies in developing and emerging economies : an analysis of the Brazilian experience

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Résumé

Cette thèse est consacrée à l'influence des cycles mondiaux de liquidité sur la dynamique des taux de change des économies en développement et émergentes (DEE) et à l'analyse des interventions de change que ces pays peuvent mener pour compenser cette influence, en se concentrant sur l'expérience brésilienne avec des produits dérivés.

Le 21ème siècle a été témoin d'une évolution des fragilités externes des DEE. Si l'accumulation de réserves internationales a réduit les risques d'asymétrie de devises dans ces économies, elle a également accru l'attrait de ces économies pour les investissements des non-résidents. Ces investissements ont une influence cruciale sur l'évolution des taux de change dans ces pays. Cependant, les décisions d'investissement des non-résidents restent attachées à ce qui se passe dans les économies du centre, générant des cycles mondiaux de liquidité qui intercalent les périodes d'entrées financières vers les DEE avec l'inversion abrupt de ces flux. Ces cycles mondiaux de liquidité génèrent une dynamique minskyenne des taux de change des DEE, où de fortes dépréciations font suite à des périodes d'appréciation prolongée de leurs devises. Cette thèse présente une revue de la littérature, puis des preuves empiriques d'un tel comportement asymétrique.

L'attention se porte alors sur l'expérience brésilienne. Dans les années 2010, la Banque centrale brésilienne (BCB) est intervenue massivement, avec des « domestic non-deliverable forwards » (DNDF), pour compenser l'inversion du cycle financier mondial. Une enquête sur les raisons pour lesquelles la BCB a utilisé ces dérivés, leur impact sur les marchés et les limites de ces interventions est présentée dans le quatrième chapitre de la thèse. On fait valoir que le principal avantage des DNDF est qu'ils préservent les réserves internationales de la banque centrale. Une évaluation empirique montre que les DNDF ont renforcé les marchés de « hedging » brésiliens en permettant l'expansion des positions courtes en dollars des « market makers ». Les DNDF ont également été utilisés pour limiter la volatilité excessive du real brésilien. Cependant, les pertes avec des DNDF étaient coûteuses et ont augmenté les passifs portant intérêt de la BCB. L'augmentation de la marge de manœuvre extérieure s'est faite au prix d'une moindre marge de manœuvre interne.

Une analyse de la manière dont le cadre comptable peut affecter la capacité opérationnelle des banques centrales des DEE conclut la thèse. La séparation des résultats réalisés et non réalisés, par exemple, peut créer des coussins de réévaluation gonflés à côté de pertes persistantes dans les économies en développement. En revanche, la consolidation et le transfert de ces résultats au gouvernement donnent la souplesse nécessaire pour intervenir sur les marchés des changes mais ils peuvent conduire à un financement monétisé indésirable. L'évolution de la législation brésilienne met en évidence ces dilemmes et suggère une alternative comptable potentielle pour ces économies.

Mot-clés: Économies émergents, cycle financier mondial, banque centrale, politiques de change.

Abstract

This thesis explores the influence of global liquidity cycles (GLC) on the exchange rate dynamics of developing and emerging economies (DEEs) and analyzes the foreign exchange interventions that these countries can adopt to offset such influence, focusing on the Brazilian experience with derivatives.

The 21st century has witnessed an evolution in the external fragilities of DEEs. While the accumulation of international reserves has diminished the dangers of currency mismatches in these economies, it has also increased the attractivity of these economies to non-resident investments. These investments have a crucial influence on the evolution of the exchange rates in these countries. However, the investment decisions of non-residents remain attached to what is happening in the central economies, generating global liquidity cycles that intercalate periods of financial inflows toward DEEs with the abrupt reversal of these flows. These global liquidity cycles generate Minskyan dynamics in the exchange rates of DEEs, where sharp depreciations follow periods of protracted appreciation of their currencies. This thesis provides a review of this literature and then empirical evidence of such asymmetrical behavior.

The attention is then shifted to the Brazilian experience. In the 2010s, the Brazilian Central Bank (BCB) intervened massively with domestic non-deliverable forwards (DNDFS) to offset the reversal of the global financial cycle. An investigation of why the BCB used these derivatives, how they affected the markets, and the limits of these interventions is presented in the fourth chapter. It is argued that the main benefit of DNDFs is that they preserve the international reserves of the central bank. An empirical assessment presents evidence that DNDFs strengthened Brazilian hedging markets by allowing the expansion of market makers' short dollar positions. DNDFs were also used to limit excessive currency volatility. However, DNDFs' losses were costly and increased the interest-bearing liabilities of the BCB. The higher external policy space came at the cost of lower internal policy space.

An analysis of how the accounting framework can affect the operational capacity of DEEs' central banks concludes the thesis. The separation of realized and unrealized results, for instance, can create inflated revaluation buffers next to persistent losses in developing economies. The consolidation and transfer of these results to the government, on the other hand, gives the flexibility to intervene in foreign exchange markets but might lead to undesired monetized financing. The evolution of the Brazilian legislation highlights these dilemmas and suggests a potential accounting alternative for these economies.

Keywords: Emerging economies, global financial cycle, central banking, foreign exchange policies.

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Chapter 1

General introduction

The first decades of the twenty-first century have witnessed important transformations in the global economy. On the one hand, the process of financial globalization has deepened with the demise of the Bretton Woods system. Financial markets are becoming hyperconnected, and the decisions made by the players operating in these markets have far-reaching consequences (Guttmann, 2016). At the same time, developing and emerging economies (DEEs) are steadily increasing their participation in the global economy and attracting investments from non-resident investors.

After the DEEs' crises of the 1990s, these countries took advantage of the international bonanza to accumulate substantial international reserves, in a process described as "one of the most robust empirical regularities in modern international economics" (Landau, 2014, p. 119). These reserves were an important factor in the relative success of DEEs to fight off the 2008 crisis (Aizenman and Sun, 2012).

Nonetheless, the arrival of the 2010s brought new challenges to these economies. In particular, the era of extremely low-interest rates and monetary stimuli pushed global investors to look for investment opportunities in DEEs. The investments into these economies led to overall pressures for the appreciation of their currencies and were accused of being a "monetary tsunami" by the former Brazilian president Dilma Rousseff (Reuters, 2012). It turned out that this state of affairs was quite unstable, and even the possibility of a reversal in the U.S. monetary policies (the "taper tantrum" episode) led to substantial instability in DEEs (Eichengreen and Gupta, 2015). The remaining of the 2010s were marked by this dance between monetary stimuli and recoiling that led to swings in global capital flows and commodity prices.

The 2010s revealed that the international monetary and financial system was still characterized by a center-periphery relationship, with the U.S. dollar (USD) at the apex of the global currency hierarchy. A key aspect of this brave new world is the synchronization of domestic economic cycles – especially in the periphery of the system. When the global risk appetite is high, global investors look for higher yields in DEEs. When global liquidity

preference increases, these investors rush to tuck their investments in USD-denominated assets.

In this hyperconnected global economy, Rodrik (2011) emphasizes that the DEEs that chose not to follow the standard recommendations of financial liberalization were the ones that fared better. Active exchange rate policies are commonly cited as one of the most important policies that led to the unequal development of DEEs in the last decades. The objective of this thesis is twofold: to better understand the exchange rate cycles in DEEs and to understand the importance of exchange rate policies in these economies. Furthermore, we take a deep dive into the Brazilian experience in the 2010s to illustrate these issues.

The Brazilian case is interesting because it represents a large DEE that intervened heavily in foreign exchange markets. It hoarded significant international reserves, and it intervened heavily in the derivatives markets. Nonetheless, the Brazilian intervention strategy was always contained in the mainstream consensus of interventions to preserve financial stability without affecting the exchange rates. The Brazilian results with these policies were mixed. On the one hand, the monetary authorities succeeded in avoiding patrimonial crises in the wake of Brazilian real (BRL) depreciation, in contrast to what happened in the 1990s and early 2000s. On the other hand, the BRL was quite volatile compared to its peers and fluctuated with global financial cycles.

The thesis is structured in six chapters, including this introduction. Chapter 2 presents a review of the post-Keynesian literature connected to exchange rate dynamics and interventions in DEEs that serves as a theoretical foundation for the three following chapters that were written as self-contained articles aimed at publication in peer-reviewed journals. A final chapter with the general conclusions closes the thesis.

Chapter 2 reviews the post-Keynesian literature connected to exchange rate dynamics and foreign exchange interventions in DEEs. In this chapter, I explore important concepts of the post-Keynesian literature. First, I explore the mechanics of foreign exchange markets. Subsection 2.2.2 of chapter 2 expands the post-Keynesian cambist interpretation of the relationship between forward and spot markets, centered on market makers, to exchange-based markets. This discussion serves as the basis for understanding the Brazilian Central Bank's interventions on derivatives markets presented in chapter 4 of the thesis. In section 2.3, I present the different strands of the post-Keynesian theories of exchange rate dynamics in DEEs. Finally, the section 2.4 of chapter 2 deals with the post-Keynesian theories of exchange rate interventions in DEEs. This chapter provides a detailed description of the structuralist post-Keynesian approach to these issues and serves as the theoretical background for the analytical chapters that follow.

Chapter 3 discusses the asymmetric relationship between the global liquidity cycle and the currencies of DEEs. One of the central tenets of the Minskyan interpretation of currency cycles in DEEs is that it is inherently asymmetrical. While the upper phase

of the global liquidity cycle (GLC) is associated with a slow but steady appreciation of DEEs' exchange rates, its reversal is often abrupt. In this chapter, co-written with Professor Pedro Rossi, we employ a novel panel model technique to assess, in a panel with 25 DEEs, whether there is evidence of such asymmetric relationship. We present robust evidence that such an asymmetric relationship exists.

The remaining analytical chapters of the thesis are concerned with the Brazilian economy. In chapter 4, I discuss the utilization of the domestic non-deliverable forwards (DNDFs) by the Brazilian Central Bank (BCB). Between 2009 and 2020, the Brazilian Central Bank (BCB) prioritized DNDFs to intervene against pressures for the depreciation of the BRL. We show that market makers are essential to the well-functioning of hedging markets. However, periods of increased uncertainty can push these agents away from the markets, making it challenging to find hedging opportunities. The BCB stepped in with its DNDFs to keep the market functioning. We present empirical evidence of this support, showing that variations on the short USD DNDFs' position of the BCB are positively related to the increase of short USD positions of market makers in the FX derivatives and spot markets. Occasionally, the BCB intervened with DNDFs to curb excessive volatility in the markets. We argue that interventions with this objective should offer a "higher-than-usual" coupon rate (synthetic USD-related interest rate settled in Brazilian markets). By focusing on interventions with this characteristic, we present evidence suggesting that the BCB could limit excessive movements of the BRL. However, we show that these policies were costly and that the losses associated with them led to an increase in the interest-bearing liabilities of the BCB. Furthermore, the insurance provided by these interventions may have served to attract speculative investments to the Brazilian markets in the first place.

Chapter 5 discusses how the accounting framework of a country can affect the operational capacity of the central bank. First, I discuss why international accounting standards might be inadequate to capture the specificities of DEEs. I then analyze the Brazilian experience, focusing on the legal changes that occurred in 2008 and 2019. The main contribution of this chapter is a simulation of the observed accounting results under alternative accounting regimes. We argue that the new accounting rules implemented in 2019 retained the policy space provided by the countercyclical hedging of DNDFs' interventions provided by the capital gains with international reserves while it limited the risk of backdoor monetary financing of the Brazilian treasury. However, government bonds are still required to back the monetary policy operations of the central bank. We argue that the adoption of remunerated reserves would circumvent this problem.

Chapter 2

Post-Keynesian theories of exchange rate dynamics and exchange rate interventions in developing and emerging economies[1]

2.1 Introduction

This chapter is divided into three sections. In section 2.2, we discuss the mechanics of foreign exchange rate markets. We define important concepts that will be explored later in the thesis, such as the foreign exchange marketplace, and we provide an analytical explanation of the agents operating in these markets. We also emphasize the crucial role of market makers as the bridge between markets of different maturities. This concept is essential to understand the interventions with domestic non-deliverable forwards (DNDFs, also referred to as FX swaps) adopted by the central bank that are analyzed in chapter 4. Finally, we tie the discussion together to explain the immediate determination of exchange rates as the market-clearing price in these markets and explain the connection between these supply and demand forces and the balance of payments. This section is essential to understand the empirical strategies adopted throughout the thesis.

In the section 2.3 of this chapter, we discuss the post-Keynesian theories of exchange rate determination. In this section, we are interested in understanding why economic agents decide to buy or sell foreign currencies in the market. We start the discussion with the general post-Keynesian view as outlined by Harvey (2009) and Lavoie (2014), and then move to the specifics of developing and emerging economies. We pay close attention to the currency hierarchy school that emphasizes the asymmetries in the international monetary

[1]The code to replicate this chapter is available at https://github.com/joaomacalos/thesis-literature-review

and financial system and connect this discussion with the literature on the global liquidity cycles. We argue that the currencies of developing and emerging economies (DEEs) are overly sensitive to the developments in the advanced economies, which lead to Minskyan exchange rate cycles. We note that an essential feature of these cycles is their asymmetrical behavior, which we discuss in detail in chapter 3 of this thesis.

Section 2.4 finishes the chapter with a discussion of the reasons behind central bank interventions in foreign exchange markets. This section deviates from our previous approach and starts with a revision of the mainstream literature. This literature introduces the distinction between precautionary and mercantilist demand for reserves, which helps understand the arguments of the different post-Keynesians strands. With this dichotomy in the background, we move to the post-Keynesian interpretations. At first, we analyze the Modern Money Theory (MMT) views on exchange rate interventions. We then synthesize different works associated with the post-Keynesian and Latin American structuralist views into a unified "structuralist post-Keynesian" view, centered around the currency hierarchy approach and on the exposure of DEEs to the global liquidity cycle as discussed in section 2.3, on the one hand, and the relationship between the real exchange rate and economic development, on the other.

2.2 The mechanics of foreign exchange markets: agents and transmission mechanisms

The objective of this section is to discuss the functioning of foreign exchange markets. As Prates (2015) and Rossi (2016) emphasize, it is crucial to understand these markets in their institutional environment to comprehend exchange rate dynamics. Since the focus of this thesis is on developing and emerging economies, the markets represented in this section are typical of these economies with relatively well-developed financial markets. We start this section with a brief overview of the different foreign exchange (forex) markets, pointing to the difference between the spot market and the derivatives markets. We then disaggregate the participants in these markets between three groups: market-makers, final clients, and the central bank. We summarize the relationship between these agents with a discussion around the flow equations of foreign currencies that allows us to depict the immediate formation of exchange rates as the interplay of the supply and demand for foreign currencies in these markets. Finally, we conclude the section by connecting this discussion with the balance of payments accounts, which can be seen as an aggregation of these forces at a lower frequency. This section lays the ground for the empirical strategies that we take in the research chapters of the thesis.

2.2.1 Martet place

Since most countries adopt a single monetary system inside their borders, all the transactions that involve foreign currency take place in the foreign exchange markets, sometimes referred to as the "forex" market. These markets are multifaceted, and it is possible to subdivide them into many spheres. For this work, it is crucial to separate the market that trades foreign currencies for immediate delivery – the spot markets – and the forex derivatives markets, where instruments attached to the exchange rate variation are traded. The derivatives markets can be further divided between over-the-counter (OTC) markets, where the contracts are defined by the parts involved in the transactions, and exchange-based markets, where the contracts are standardized and traded in a common place. While OTC markets offer flexibility for the agents engaging in the transaction, they are much less liquid, and financial problems with one of the parts can expose the other. The standardization of exchange-based markets, on the other hand, lacks flexibility but allows many agents to enter these markets at the same time. Hence, there is a tradeoff between liquidity and flexibility. One important characteristic of forex derivatives markets is that they do not necessarily involve an actual foreign currency transaction. For example, in the Brazilian case, all the exchange-based forex derivatives markets involve the instruments that are attached to the variation of the Brazilian real (BRL) – usually against the U.S. dollar (USD) – but are settled in BRL only (Prates, 2015). This characteristic of the Brazilian markets empowers the interventions in these markets, which we explore in chapter 4.

The forex markets can also be divided between onshore markets, which abide by domestic legislation, and offshore markets, located in global financial centers and where multiple currencies can be exchanged following the legislation in place in these centers. While offshore markets can substantially impact the developments on onshore markets (Prates, 2015; Rossi, 2014), it is not easy to obtain reliable data on their functioning. Therefore, in our work, we will focus on the developments in onshore markets.

The most common over-the-counter markets are forward currency contracts, in which the parties agree to trade a pair of currencies on a future date. On the other hand, future currency contracts are traded in exchanges. These contracts are standardized, i.e., they have pre-defined settlement dates and can be exchanged between different agents before the settlement date. Other FX derivatives contracts are options to buy or sell a given currency in the future and foreign exchange swaps. The latter usually consists of an agreement to swap the principal and interests on a loan for the principal and interests on a loan of the same value made in a different currency.

Nonetheless, the term is generic and used in different contexts. For example, the Brazilian central bank consistently intervenes with "domestic" foreign exchange swaps, offering contracts that swap interest payments in BRL for interest payments in a syn-

thetic USD interest rate and adjusted for the period's exchange rate variation. These interventions are analyzed in detail in chapter 4.

2.2.2 Market participants

A foreign exchange transaction is nothing more than an exchange between a foreign currency and a local currency (Mehrling, 2013a; Plihon, 2010). Since the circulation of foreign currencies is virtually forbidden in most countries, exchange rate transactions are intermediated by market makers that can circulate between different market places. Although final clients can get foreign currencies in cash (at foreign exchange kiosks, for example), most of the transactions with settlement in the forex markets are executed by market makers simultaneously debiting and crediting a bank account in the local economy and abroad (Plihon, 2010; Ryan-Collins et al., 2014). On the other hand, these banks usually resort to the interbank market to meet their foreign exchange needs, which is also the market where the central bank acquires or sells its foreign exchange reserves. Therefore, from an analytical perspective, it is useful to segment the market participants in the foreign exchange markets according to why they engage in exchange rate transactions. We identify three analytical groups: market makers, final clients, and the central bank. This distinction is reminiscent of Harvey's (2009), but with the addition of the central bank as a relevant player and the consolidation of "retail" and "wholesale" into market makers. It is important to emphasize that this distinction is analytical, and in reality, it is common to see, for instance, a bank that acts as a market maker and speculate in the same market (Bjønnes and Rime, 2005; Harvey, 2009).

2.2.2.1 Market makers

We consolidate as market-makers the "wholesale" and "retail" activities referred to by Harvey (2009). These agents play a fundamental role in foreign exchange rate markets by providing liquidity to the markets. Commercial and investment banks that operate on foreign exchange rate markets are the most important agents that fulfill the role of market makers (Harvey, 2009).[2]

Since market makers are always ready to buy or sell foreign currencies on demand, they are an important gear of foreign exchange rate markets. The main source of their profits is the margins they apply on their prices – the bid-ask spread. Although this activity might look like "risk-free" arbitrage, market making involves significant risks (Bjønnes and Rime, 2005; Bouchaud et al., 2018; Mehrling, 2013b; Mende and Menkhoff, 2006). As Harvey (2009, p. 39, emphasis in the original) notes, "because they earn their

[2]There are other agents that operate as market makers, especially at the retail level, but we can safely ignore them at the analytical level since they only have a minor effect on the markets. These are, for instance, exchange rate kiosks, restaurants, or hotels. They provide or absorb foreign currencies on demand from clients – mostly for tourism – and charge a sizeable bid-ask spread.

income on the narrow spread between bid and ask prices, they must quote prices that they anticipate will generate an equal volume of business on both sides of the market. If they are incorrect, then their inventories of currencies accumulate in a way that creates for them a vested interest in future exchange rate movements."

Therefore, market makers operate to keep a balanced inventory of foreign currencies, i.e., they avoid the buildup of open short or long positions in foreign currencies. However, since these agents need to operate with large volumes to make profits, unexpected movements can leave them exposed to significant exchange rate risk. Consequently, they are constantly trying to anticipate exchange rate trends and take active measures to control their inventories. Such work requires great sophistication and leverage, and only large institutions can do so (Harvey, 2009; Lyons, 1995).[3]

Therefore, market makers must constantly monitor the markets and make forecasts about possible short-run trends not to be caught with an open position. To control their inventories, market makers can increase their margins in response to unusually large orders, as they might suggest that the client initiating this order has relevant information unavailable to the market maker. They can also adjust the midpoint of the spreads they offer in the markets to induce trades in a direction that would help them close their positions (Lyons, 1995). To illustrate this point, imagine that a market maker received an order to sell USD to a client. To keep the example simple, let us suppose that this order led this market maker to have an open short-USD position. Since this bank is not interested in taking a position in the market, it will probably raise its margins, i.e., the prices at which it is willing to trade USD, thus raising the USD's price (the exchange rate) in the market. Furthermore, it is common for market makers to close unwanted positions in the interbank market, where they trade with other market makers at usually much lower bid-ask spreads (Bjønnes and Rime, 2005; Garcia and Urban, 2004). Bjønnes and Rime (2005) present evidence that support these claims, showing that forex dealers of a large Scandinavian bank take about 15 minutes to absorb inventory shocks and reestablish their desired foreign exchange position.

Although most of the works referenced so far deal with market makers operating in spot markets, there is nothing that prevents these agents from playing this role in derivatives markets. In fact, before the existence of liquid exchange-based markets, derivatives markets were dependent on the existence of banks to quote forward prices on demand (Coulbois, 1972, 1979; Coulbois and Prissert, 1974). More importantly, the forex derivatives markets allow market makers to close their positions in markets of different maturities as well. That they frequently did so was emphasized early on by advocates of the cambist view, which was based on the observations of practitioners operating in foreign exchange

[3]Although it is true that technological improvements in the trading systems are reducing overall spreads and opening these markets for smaller players (Bjønnes and Rime, 2005), they remain, at least in the Brazilian markets – the focus of this work – relatively concentrated and dominated by commercial and investment banks (Prates, 2015; Rossi, 2014).

markets (Coulbois, 1972, 1979; Coulbois and Prissert, 1974) and incorporated into the post-Keynesian tradition (Lavoie, 2001, 2002, 2014, 2019; Moosa, 2017; Smithin, 2002).

Therefore, market makers' operations are most profitable when initiated by their clients, for they can extract larger bid-ask margins. Hence, they must take a relatively passive role in these markets, accepting orders with the expectation that they will eventually receive an order with the opposite sign that will allow them to close their open positions. However, only a coincidence would make such purely passive positioning profitable because these agents would be at the mercy of the short-run trends formed during the day that are subject to bandwagon effects, as argued by Harvey (2009) and Schulmeister (1987) and discussed more extensively in subsection 2.3.1. Consequently, market makers accept client orders and then act to close these positions by adjusting their margins in the direction that would help them close their positions, transmitting price pressures between different markets in the process of keeping their inventory balanced.

It is important to take a closer look at how market makers make profits, as it explains this transmission mechanism in detail. As we saw, their primary source of profits is the bid-ask spread they collect by providing liquidity on both sides of the markets. In traditional OTC markets, for example, market makers take the spot price as given and make the markets by quoting forward exchange rates on demand. The price offered to clients is the one that allows them to hedge their open positions in the spot market with a profit (Coulbois, 1979; Lavoie, 2014). Future contracts, on the other hand, are negotiated in exchanges. Therefore, the price of these contracts is determined by the trades in such exchanges. As shown by Bouchaud et al. (2018), market makers place limit orders to buy (sell) slightly below (above) the price of the last trade while monitoring their inventories to avoid the buildup of net short or long positions. The distance between the limit orders to buy (the "bid" price) and to sell (the "ask" price) forms the bid-ask spread, and the actual prices – that corresponds to the settlement prices of the last trade that takes place – are known as the "mid" prices.

Within the context of foreign exchange markets, market-makers' costs to close their positions in markets of different maturities depend on the interest rates associated with both currencies in question. The relationship that connects these interest rates with the observed exchange rates is expressed by the covered interest parity (CIP)[4] condition, as in Equation 2.1:

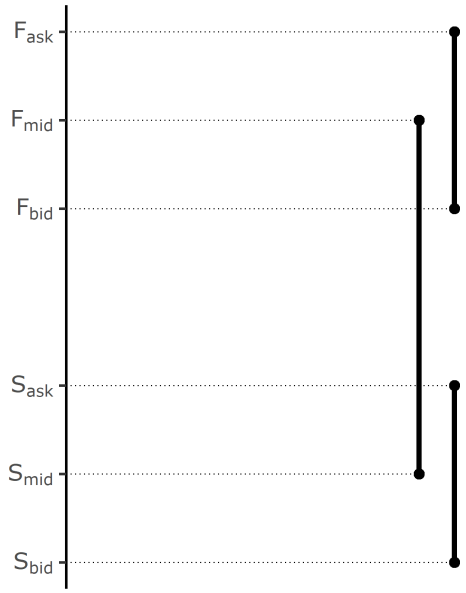
$$F = S * \frac{1+i}{1+i^*} \tag{2.1}$$

where F is the forward (or future) exchange rate, S is the spot exchange rate, and i, i^* are, respectively, the domestic and the international interbank interest rates. We use the direct quotation notation to define exchange rates – e.g., an exchange rate that is rising

[4]We ignore any country-risk premium for simplicity.

means that the currency is depreciating. Since any exploitable deviation from the CIP would allow riskless arbitrage operations initiated by clients, the prices stated by the CIP are the benchmark for market makers. Therefore, it is around the exchange rates (spot and forward) implied by this parity that they set their bid-ask spreads, determining both prices contemporaneously and independently of any expectation about the movement of the exchange rates in the future (Coulbois, 1979; Lavoie, 2014; Mehrling, 2013b). In other words, it is the CIP condition that determines the distance between the spot and futures prices. A schematic representation of prices in the forward and spot foreign exchange markets is presented in Figure 2.1.

Figure 2.1: Representation of the forward-spot exchange rates' relationship



Author's elaboration.

By passively taking orders from clients, the market makers are always on the favorable side of the trade. For example, when a limit order from an FX dealer to buy a future USD is executed, the operation is settled at the bid price (F_{bid}) that then becomes the new mid-price, triggering a cascade of new limit orders. The FX dealers carry an exchange rate risk until an order of the opposite sign arrives, but they generally execute many orders in a day and can, on average, profit from the difference between F_{ask} and F_{bid} (Bjønnes and Rime, 2005). Very importantly, they can also close their positions in markets of different maturities. For instance, they could match net long positions in the future markets with net short positions in the spot markets. In this case, they would have to execute complementary operations and borrow USDs on the international money markets to sell them on the spot market – thus eliminating the exchange rate risk –, and then invest the proceedings in the domestic interbank market. Assuming that the FX dealer borrows and

lends in the domestic and international interbank markets at average market prices[5], the dealers' profit in this operation is the distance between the price they bought the future USD (F_{bid}) and the mid-future USD price (F_{mid}) that is associated with the international interbank interest rate (i^*) plus the distance between the price they sold the spot USD (S_{ask}) and the mid-spot USD price (S_{mid}) that is associated with the domestic interbank rate (i).

As we are going to discuss more extensively in chapter 4, many authors noted this crucial aspect of market makers in the transmission of prices from the Brazilian derivatives markets to the spot BRL market (Prates, 2015; Rossi, 2016; Ventura and Garcia, 2012). These works point to a speculation-arbitrage relationship, for clients would create speculative pressures in the Brazilian futures market, and these pressures would be transmitted by arbitrage to the spot markets. Although agreeing with the substance of these claims, we disagree with its classification as arbitrage. What makes market-making different from classical arbitrage is that market makers do not initiate the operations but charge a price – the bid-ask spreads – to take on these positions passively. Market makers then adjust their prices and go to different markets, searching for a hedge for their open inventories. Therefore, even if these markets are exchange-based, with the prices being formed through limit-order books, the CIP – understood as the price interval between the margins (i.e., between F_{ask} and S_{bid} in Figure 2.1) – should hold at all times and regardless of future expected spot rates. Furthermore, this interpretation also places market makers and their pricing decisions in center stage, a key tenet of the post-Keynesian interpretation (Lavoie, 2014).

2.2.2.2 Final clients

We classify as final clients all the private agents that initiate an operation to buy or sell a foreign currency in the foreign exchange markets. This is a heterogeneous group that includes households that need foreign currency for tourism, firms that need foreign currency to purchase goods abroad or to convert their proceedings, companies that wish to make investments in a foreign country, financial investors that need foreign currency for long-run portfolio investors, speculators that want to operate in the short-run, among others. Without public intervention, it is the collective action of final clients that drive the foreign exchange markets, as market makers react to the supply and demand forces generated at the commercial level to keep their inventory balanced. Therefore, to understand the determination of exchange rates, it is essential to understand how these agents form their expectations and why they enter the markets (Harvey, 2009). This discussion is the topic of the third section of this chapter. Here, the objective is to broadly characterize the final clients to describe the mechanics of foreign exchange markets.

[5]We are assuming away the bid-ask spread involved in these operations to focus our attention on the FX markets, although its inclusion does not change the results (Moosa, 2017).

Since this is a heterogeneous group, it is useful to subdivide it to understand better the final demand for foreign currencies in a market. One possible division is between institutional sectors. If we divide the final clients this way, we end with households that enter the foreign exchange markets through tourism or remittances, with non-financial corporations that need foreign currencies for activities related to trade or direct investments, and with financial institutions that undertake portfolio investments abroad or at home. We include in this final group speculators and noisy traders that aim to profit from short-run volatility.[6]

Another possible division relates to the reason behind the demand or supply of foreign currencies in the market. In this sense, the final clients can be divided into four groups: those who enter the market to meet their immediate needs, those who enter the markets to speculate, those who enter the market to hedge their operations, and those entering the market to exploit some arbitrage opportunities. In the first group, we have the agents that will enter the market according to their needs and regardless of the exchange rate level. Examples of participants classified in this group are households that receive remittances from abroad and importers and exporters – as long as they do not delay or anticipate their transactions to profit from expected price changes. Speculators are all the agents that hold an open position in the market – be it short or long – with the expectation to make a profit from price changes. Hedgers are the agents who have exposure to foreign currency and enter the market to secure a stable exchange rate, stabilizing their long-run expectations and enhance their future cash-flows predictability. Companies involved in foreign trade, for example, can enter the market as hedgers since their production decisions might take place several months before the actual need to import inputs or the day when they will settle their sales. When hedging, these companies pay a small premium to secure an exchange rate. These transactions usually take place in the derivatives markets (Farhi, 1999).

Finally, arbitrageurs actively look for exploitable distortions in correlated assets. Ideally, arbitrageurs would like to operate with perfectly correlated assets like spot and future exchange rates, for example. However, it is virtually impossible to make profits with these operations on the wrong side of the bid-ask spread. Therefore, many arbitrageurs look for correlated prices and volatilities. To illustrate this idea, imagine that an investor concludes that the Brazilian Real and the Mexican Peso are correlated currencies, but some short-run volatility altered their relative prices. This investor could buy one of these currencies and sell the other to make arbitrage gains. In the late 1990s, the LTCM hedge fund became famous for making huge losses with this type of arbitrage operations. The LTCM case questions the risk-free status of such arbitrage operations and blurs the distinction between arbitrage and speculation (Farhi, 1999).

[6]It is important to note that this division is analytical, and nothing prevents non-financial corporations to look for foreign currencies to make portfolio investments abroad.

To summarize, final clients push the exchange rates as they actively demand or supply foreign currencies in the markets. As Harvey (2009, p. 39) says, it is from these agents that "the ultimate demand for currency arises, and thus where exchange rates are determined." This is the case regardless of the nature of their investments. For example, if a company hedges its future export income, its decision to hedge will affect the futures markets right away, while the spot market will be affected on the day when it repatriates its proceedings in the forex markets, even if these forces operate in different directions. The key aspect here is that these operations do not take place at the same time.

2.2.2.3 Central bank

Finally, the last participant in the foreign exchange rate markets is the central bank. The actions of central banks are more obvious in fixed exchange rate regimes, as they must intervene in the markets by supplying or absorbing foreign currencies to keep the exchange rate around its nominal target. However, central banks can also intervene in floating exchange rate regimes, and they usually do so in emerging economies. For example, the central bank can buy U.S. dollars in the markets to meet the government's external debt obligations, or it can accumulate international reserves to build a war chest of foreign resources to use in times of crisis. We deal with the reasons behind central bank interventions in the forex markets in the fourth section of this chapter.

What is important to retain here is that the central bank is a strong player that can significantly impact the determination of the exchange rate, especially in DEEs. According to Stone et al. (2009), sterilized FX interventions affect the exchange rates through three channels. The first channel is the order-flow or microstructural channel, where the central bank's interventions affect the inventories of market makers that in turn adjust their prices in the different forex markets, thereby affecting the decisions of final clients. The second channel is the portfolio balancing channel. In a world where different currencies are not perfect substitutes, central bank interventions impact the expected returns of currency portfolios, which can trigger a portfolio rebalancing of international investors. Finally, the last channel is the signaling or expectations channel. Through this channel, the central bank makes it clear for market participants what its intentions are, hoping to affect their expectations regarding the future of the exchange rate. As we discuss chapter 4, the DNDFs auctioned by the Brazilian authorities affected the Brazilian forex markets through similar channels.

2.2.3 Exchange rate mechanics: the net foreign exchange flows equation

After this overview of the foreign exchange markets institutions and their typical participants, we step towards a higher level of abstraction to comprehend these markets'

mechanics. Adapting the forex flows equations presented by Rossi (2016a), the net transactions in the foreign exchange markets can be summarized as follows:[7]

$$NFX_t = \Delta MM_t + \Delta CB_t \tag{2.2}$$

Where NFX_t – the net flow of foreign currency to the country – is the difference between the supply of and demand for foreign currency from final clients exchanged in the foreign exchange market in a period t. ΔMM_t is the variation in the inventories of market makers in period t, and ΔCB_t is the variation in the central bank's stocks of international reserves, i.e., its net interventions in period t.

This equation highlights that the only way to have positive or negative net flows of foreign currencies at the final clients' level is when market makers, on the aggregate, or central banks are willing to change their inventories of foreign currencies. If the central bank abstains from intervening in the markets, as would be the case in a perfect floating exchange regime, and market makers are successful in keeping their inventories exactly unchanged, the net flows of foreign currency will also be equal to zero, meaning that the effective supply of foreign currency will be equal to the effective demand for foreign currency. In this particular scenario, all the demand and supply pressures formed at the level of final clients is absorbed by the exchange rate.

To gain more insights into the dynamics of foreign exchange markets, it is useful to disaggregate the sectors in Equation 2.2 to separate the effective supply and demand in the foreign exchange markets:

$$NFX_t = S_t^{FC} - D_t^{FC} \tag{2.3}$$

$$\Delta MM_t = D_t^{MM} - S_t^{MM} \tag{2.4}$$

$$\Delta CB_t = D_t^{CB} - S_t^{CB} \tag{2.5}$$

Where the net flow of foreign currency is equal to the difference between the effective supply and demand of foreign currency by final clients (Equation 2.3); the variation of the market makers' foreign currency position is equal to the difference between its demand and supply of foreign currency in the forex market (Equation 2.4), and the interventions of the central bank are equal to the difference between its acquisitions and sales of international reserves in the foreign exchange rate market (Equation 2.5). Furthermore, we could

[7] We omit "errors and discrepancies" to emphasize its analytical nature.

further separate the net flow of foreign currency from final clients between the flows associated with trade and income and the flows associated with financial transactions:

$$S_t^{FC} = S_t^{FC.T} + S_t^{FC.F} \tag{2.6}$$

$$D_t^{FC} = D_t^{FC.T} + D_t^{FC.F} \tag{2.7}$$

We can now identify the total effective supply of and demand for foreign currencies in the foreign exchange markets by combining equations 2.3, 2.4, 2.5, 2.6, and 2.7 with Equation 2.2 and rearranging the terms:

$$S_t^{FC.T} + S_t^{FC.F} + S_t^{MM} + S_t^{CB} = D_t^{FC.T} + D_t^{FC.F} + D_t^{MM} + D_t^{CB} \tag{2.8}$$

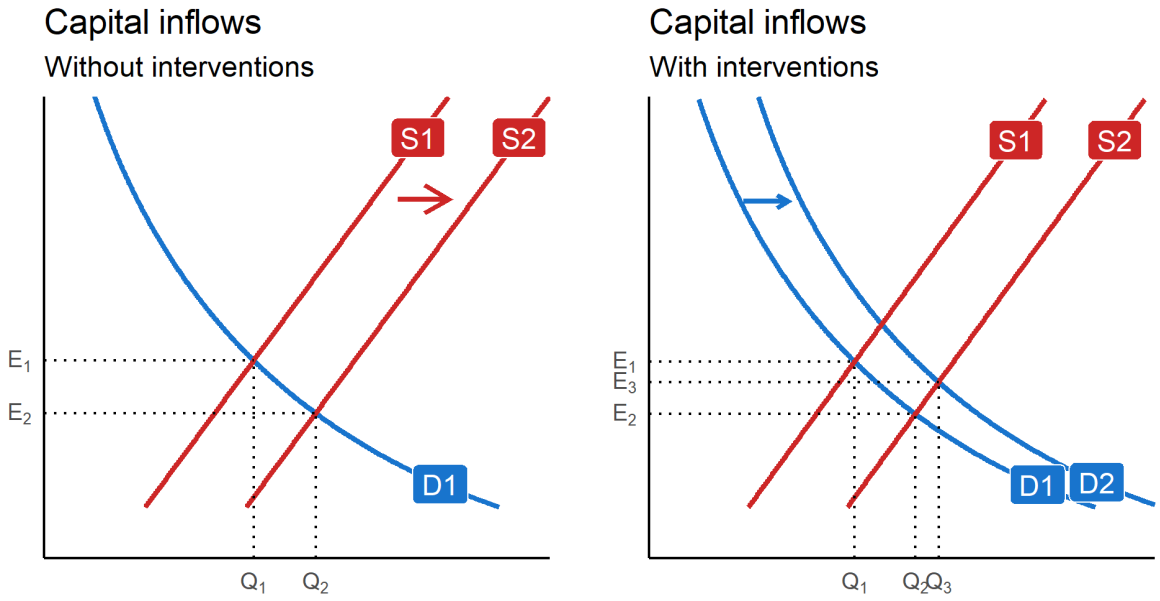
If it were possible to measure the items in Equation 2.8 in a real economy, the values would represent the point where each of these demand curves would be satisfied, giving the exchange rate formed in the market. Therefore, it is possible to represent this equation with supply and demand diagrams to visualize what we would expect to happen if there was some exogenous variation in one of its elements.[8] For example, suppose that a reduction in the international liquidity preference – a concept that we will deal with later in this chapter – trigger portfolio financial flows to the local economy. Such an exogenous increase would shift the aggregate supply curve to the right. The demand curve, on the other hand, would not shift. Therefore, the exchange rate would appreciate, moving from E1 to E2, as shown in the left diagram of Figure 2.2. Assuming that the central bank and the market makers wish to keep their inventories stable, the movement along the demand curve is captured by an increase in the demand for imported goods or an increase in the demand for foreign currency to make investments abroad. Since we are focused on DEEs, we would most likely expect an increase in imports. The central bank could, nonetheless, intervene in the forex markets and accumulate international reserves. Such a reaction would have the effect of shifting the demand curve to the right, as presented on the right side of Figure 2.2. In this example, the central bank's intervention partially offset the appreciation of the exchange rate induced by the exogenous inflows of capital.

On the other hand, we see that the quantities traded are higher than before the central bank's intervention. Therefore, when the central bank intervenes in the forex markets, it offers a quantity adjustment that offsets, at least partially, the appreciation of the

[8] This is the strategy adopted by Harvey (2009, chapter 4), although he uses balance of payments concepts in his diagrams. We prefer the net foreign exchange flows equation for two reasons: we avoid the residency-based division of the concepts, which is at the core of balance of payments statistics, and we avoid using concepts that are directly attached to the current and financial accounts. In this way, we emphasize that the exchange rate is formed as the result of the interplay of forces in the foreign exchange market. We discuss the relationship between these concepts and the balance of payments statistics in the next subsection.

exchange rate. The evidence gathered by Kohlscheen (2013) from the Brazilian Central Bank corroborates this point. This author uses a comprehensive order-flow dataset to show that the effect of USD sales by commercial customers on the exchange rate was much stronger when the central bank did not intervene than in the days when it intervened.

Figure 2.2: Effect of capital inflows on foreign exchange markets



Author's elaboration.

2.2.3.1 Relationship with the balance of payments

As stated by the IMF (2018b, p. xxvii) balance of payments statistics yearbook, "the international accounts [balance of payments and international investment position] for an economy summarize the economic relationships between residents of that economy and nonresidents." Therefore, these statistics are always divided by the residency of the economic units in question. The best way to connect the balance of payments' statistics and the net flow of foreign currency discussed above is to start from the simplest BOP identities and gradually increase the complexity. In an accounting sense, the balance of payments always "closes" since the current account balance will always be equal to the accounting financial account balance:

$$ABP = CAB + AFAB = 0 \tag{2.9}$$

However, this definition of $AFAB$ includes the variation of official reserves (ΔOR). Therefore, it is common to describe the economic balance of payments as:

$$BP = CAB + FAB = \Delta OR \tag{2.10}$$

Rearranging the terms, we have that the current account balance is equal to the variation in official reserves minus the financial account balance:

$$CAB = \Delta OR - FAB \tag{2.11}$$

At the current account level, the question of residence is straightforward, as it simply shows the difference between the exports and the income received by residents against the sum of all the imports and the income payable to nonresidents in a given period. On the other hand, the financial account is more complex, as it deals with the net acquisition and disposal of financial assets and liabilities. In other words, the financial account registers the net acquisition of assets by residents abroad and the net incurrence of liabilities of residents with nonresidents. Therefore, one must always be careful when defining an economic quantity such as capital flows. For example, a capital outflow means that either a resident is increasing its assets abroad or that a nonresident is quitting the local economy. In the first case, the capital outflow is recorded in the financial account as a positive variation in the net acquisition of assets, while in the second case, the capital outflow is recorded as a negative variation in the net incurrence of liabilities. We can rewrite Equation 2.10 to make it more expressive in this sense:

$$FAB = NIL - NAA \tag{2.12}$$

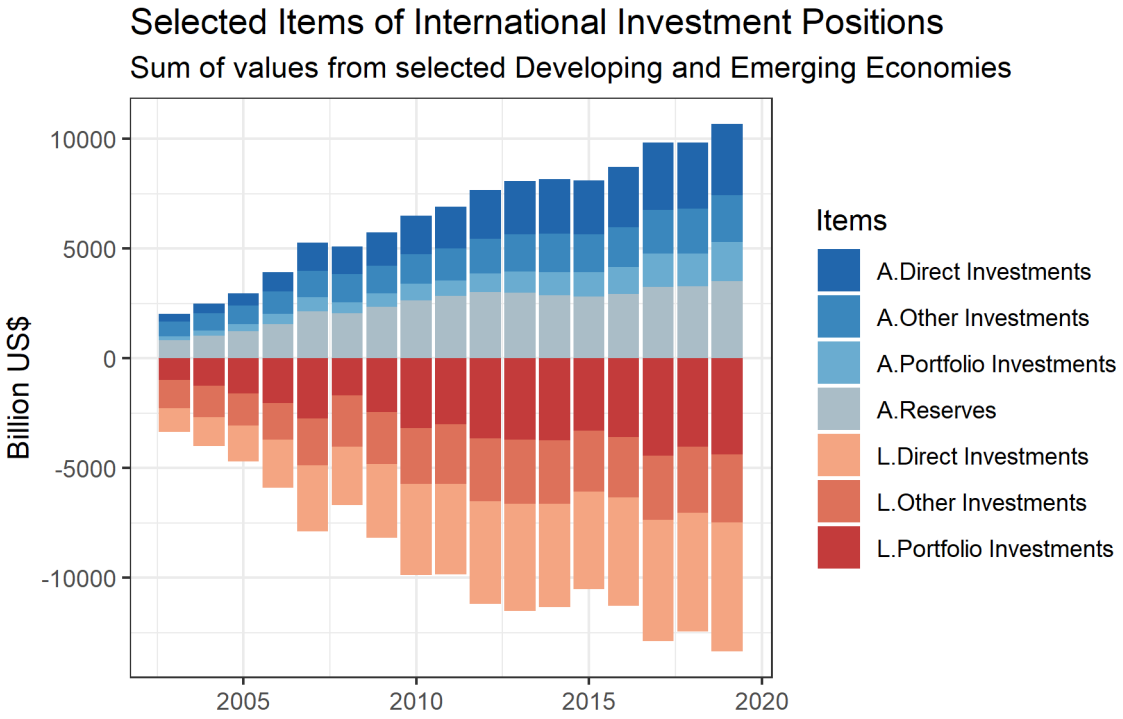
$$CAB = \Delta OR - NIL + NAA \tag{2.13}$$

Where NIL is "net incurrence of liabilities" and NAA is "net acquisition of assets." In the balance of payments, these assets and liabilities are divided further into its different components. Analytically, a reasonable level of granularity is the division between direct investments, portfolio investments, other investments, and the accumulation of reserves. Since these flows lead to the formation of stocks, they are consolidated in each country's international investment position.

Here we make a small digression to present some descriptive international investment position statistics of DEEs that are useful to understand the empirical choices that we made in the chapter 3. A common theme in this thesis is that international investors are especially relevant in determining the exchange rate and the balance of payments dynamics of DEEs. Therefore, a common strategy to measure the global liquidity cycle and the effect of capital flows in these economies is to ignore the net acquisition of assets and focus on what is happening with the net incurrence of liabilities, which captures nonresidents' behavior. We adopt this strategy in chapter 3.

Furthermore, the most important item of the external assets of DEEs is their international reserves, as shown in Figure 2.3.[9] Figure 2.3 also shows that both assets and liabilities increased steadily since 2003 – reflecting the growing importance of DEEs in the global economy. It also shows that this group of DEEs, in its aggregate, held a net external debt in the period. It is also interesting to note that portfolio investments are the smaller component of their external assets. On the other hand, their liabilities are composed mostly of direct investments in these economies, although portfolio investments are also relevant. For example, the proportion of portfolio assets to liabilities was, on average, equal to 27% of their portfolio liabilities. This fact further justifies our choice to focus on the net incurrence of liabilities and its portfolio component as the main indicators of capital flows to these countries.

Figure 2.3: Selected items of international investment positions of developing and emerging economies.



Source: IMF - Balance of payments statistics.
Author's elaboration.

To close this section, we need to discuss the relationship between the balance of payments accounting identities and the exchange rate determination. Looking at Equations 2.9 to 2.13, one is tempted to draw a causal connection between the current account balance and the financial account balance. After all, in the absence of variations in the stock of official reserves, these two accounts must be equal to each other. However, it is

[9] We display the evolution of these items for the 25 DEEs that we used in the empirical analysis in chapter 3.

essential to emphasize that the balance of payments is an ex-post measurement and that the decisions that drive the items in the current account are virtually independent of the decisions that drive the financial account (Harvey, 2019). As we argued in the previous subsection, the exchange rate is the price that equalizes the effective supply and demand for foreign currency in the forex market. The balance of payments only reflects their composition. For example, if the effective supply of foreign currency is composed mostly of portfolio investments in the local economy by nonresidents, we will have, in terms of the previous section, that

$$S_t^{FC.T} < S_t^{FC.F}$$

If at the same time, the demand for foreign currency happens to be dominated by imports, we have

$$D_t^{FC.T} > D_t^{FC.F}$$

This state of affairs characterizes a current account deficit and a financial account surplus. However, it does not mean that nonresidents are directly financing higher imports in the local economy. They are, in this example, willing to make portfolio investments in the economy. The importance of the last section was to emphasize exactly that the interplay of different decisions by different actors in the foreign exchange markets, summarized by their bids in this market, leads to the formation of the exchange rate as the price that clears the market.

2.3 Post-Keynesian theories of exchange rate dynamics in Developing and Emerging Economies

The objective of this section is to discuss the post-Keynesian theories of exchange rate determination in DEEs. We start by outlining the general post-Keynesian approaches to exchange rate dynamics, inspired mostly by Harvey's (2009) work and the summary in Lavoie (2014). We then review the contributions of the currency hierarchy approach, which emphasizes the structural asymmetry of the international monetary and financial system and the influence of the global liquidity cycle on the DEEs. We conclude the section with the presentation of the structuralist post-Keynesian view, which emphasizes Minskyan exchange rate cycles in these economies. The discussion of this section is important to understand the empirical analysis we propose in chapter 3.

2.3.1 Exchange rate dynamics

Exchange rate determination is one of the most contested points of economic theory. Although purchasing-power-parity (PPP) and uncovered interest parity (UIP) theories are usually cited in mainstream textbooks as the relevant theories for understanding exchange rate dynamics in the long and short run (Krugman et al., 2018; Mankiw, 2020), the empirical evidence about their validity is not conclusive at best. Hence, the reason behind the large fluctuations of exchange rates remains an open economic question (De Grauwe, 2014; Sarno and Taylor, 2002). As Lavoie (2014) and Mitchell et al. (2019) argue, post-Keynesians seem to be as puzzled as mainstream authors by exchange rates. However, post-Keynesians tend to offer a more holistic or exploratory view of exchange rate determination, paying close attention to the historical evolution of foreign exchange markets, and trying to delineate theoretically the stylized facts that help one to understand the developments in these markets without aiming to provide a deterministic model capable of predicting the trajectory of exchange rates (Harvey, 2009; Schulmeister, 1987).

The most prolific post-Keynesian author to write on exchange rate dynamics is Harvey (2003, 2009, 2019). His main argument is that capital flows are the key force in determining exchange rates in modern economies. Furthermore, he emphasizes that the forces determining these capital flows are independent of the forces determining trade flows. In such a scenario, the driving forces of currency prices are the portfolio decisions of global investors that operate in currency markets. Such a framework is keen to Keynesians and post-Keynesians as it is rooted in Keynes' (1936) analysis of financial markets and their conventional behavior. As Harvey (2009) argues, portfolio investors act in an uncertain world, and there is no intrinsic connection between their investment decisions and the determinants of international trade. Therefore, he rejects that exchange rates tend to a level that creates a balanced trade account in the economy. As he argues, "although trade flows (the real sector) can impact the currency price, the far larger and more volatile movements of short-term capital take center stage in today's economy. They are cause and not effect" (Ibid, p. 7).

In Harvey's (2009) framework, the expectations of the agents operating in the foreign exchange rate markets – that we labeled as final clients – are crucial to understanding its dynamics. As we saw earlier in subsection 2.2.2, the agents operating in the foreign exchange markets can be divided analytically between final clients, market makers, and the central bank. The final clients can be further divided between agents operating in the goods markets and agents operating on the assets market. Understanding the decision-making process of the international investors that operate on global capital markets is key to understand Harvey's theory. Drawing on insights from behavioral psychology and Keynes' (1936) beauty contest view of financial markets, the author emphasizes how these investors make their decisions based on how they think that the other agents will react to

changes in the markets. Therefore, it is crucial to consider the mental models that these agents have about the currency markets to understand exchange rate dynamics.

As Harvey (2009, p. 52) argues, the combination of these ideas suggests that currency prices go through cycles of volatility that are a function of uncertainty, representativeness, anchoring, availability, animal spirits, and conventions. In a world characterized by these cycles, currency prices are subject to bandwagon effects that are understood as periods when prices move up or down only because they have done so in the past. Agents "jump on the bandwagons" by purchasing the appreciating asset or selling the depreciating one, having no more justification than "everyone else seems to be doing it." It is the existence of bandwagons that allow technical (chartist) analysis to be profitable. However, the author notes that if the price changes become too intense, investors lose confidence in their forecasts and back down from their bets in the markets.

Schulmeister's (1987) work is useful to understand better the role of final clients in the foreign exchange markets. He starts by making a clear theoretical distinction between short-run and medium-run exchange rate dynamics. In the short-run, the market is dominated by speculators that operate from trade rooms with the help of technical analysis[10] (and algorithmic trading nowadays). This author provides evidence of the profitability of technical analysis in foreign exchange rate markets, which was in line with current practice in currency trade rooms at the time of his writing, and appears to be still profitable nowadays (Schulmeister, 2006, 2009). Technical analysis is profitable because exchange rates follow patterned upward and downward movements that are exploited by traders. On the other hand, the behavior of traders reinforces the movements as they tend to accentuate such short-run trends (Schulmeister, 2006).

Evolving disequilibria in goods and financial markets can explain medium-run exchange rate dynamics. These disequilibria express themselves in a sequence of "bubble-like" movements upward and downward due to the interplay of expectations regarding the goods and assets markets. Schulmeister (1987) differentiates between unambiguous and ambiguous medium-run scenarios. For example, when a country is experiencing trade deficits and offering real interest rates below global rates, both markets suggest that the currency of this country should depreciate, and agents unambiguously expect a depreciation. Ambiguous situations arise when, for instance, a country is experiencing current account deficits but offering a positive interest rate differential. These situations give mixed signals to the markets. He labels such a scenario as a "precarious equilibrium" (Schulmeister, 1987, p. 36).

For Schulmeister (1987), both short-run traders and medium-run portfolio investors profit from the variation of exchange rates. In other words, they make profits by speculating on these markets. Furthermore, both types of agents form qualitative (i.e., directional) expectations. The difference between them is that short-term investors focus on predicting

[10]Technical analysis is the search for exploitable patterns in the charts of past prices (Rossi, 2016)

– either by recurring to technical analysis or by appealing to an implicit understanding of the market's psychological conditions – how the other agents will operate in the short-run. In contrast, portfolio investors that operate in the medium-run focus on the fundamental forces of the market. This distinction is in line with the work of Lavoie (2014) and Lavoie and Daigle (2011), where the forex market is divided between fundamentalists and chartists or speculators. It is interesting to note that, for Schulmeister (1987), the views of short-run speculators do not affect the expectations of medium-run portfolio managers, while the expectations of the latter affect how the former trades. Therefore, short-run speculators add volatility to the medium-run trends formed by portfolio investors.

Despite the importance of portfolio flows, many post-Keynesians maintain that current account balances are important to determining exchange rates, especially in developing and emerging countries, but not only. Most of this literature is associated with the Thirlwall law (McCombie, 2003; Thirlwall, 2011), but it is also important to mention Godley and Cripps (1983), Godley (1999), and Godley and Lavoie (2007). Based on stock-flow consistency, Godley argues that while portfolio decisions might have a brisk impact in the short-run, their long-run effects are close to nil, while trade shocks slowly but permanently affect exchange rates, bringing the current account back to equilibrium (Lavoie, 2014). This line of reasoning is consistent with Schulmeister's (1987) claim that the purchasing power parity acts as a long-run center of gravity of exchange rates, attracting the exchange rates, although only a coincidence would make the prices exactly like what is predicted by PPP.

In sum, post-Keynesians argue that, in the short-run, the forces driving the exchange rate are tied to the behavior of traders and other speculators that operate with technical analysis and financial algorithms. These are the chartists. The medium-run dynamics are set by portfolio investors that keep an eye on the fundamentals of the economy, be they real fundamentals like the balance of trade or financial fundamentals like interest rates or stock market prices. If the signals emitted by these markets are contradictory, financial markets tend to prevail. However, the longer portfolio investors remain in positions that are in disagreement with the trade performance, the riskier their position tends to become. In the limit, something might trigger a panic or a financial crisis that can lead to capital outflows. In this scenario, the current account will have to bear the adjustment of the exchange rates. The chartists add fuel to the fire, increasing the volatility of the markets, and have a destabilizing effect if they are overrepresented in the market (Lavoie and Daigle, 2011). Yet, many post-Keynesian authors argue that current account imbalances can remain in place for years (Mitchell et al., 2019; Wray, 2015). Indeed, the recent experience of the United States has shown this point quite explicitly. In fact, even in 2008, after the crash of Lehman Brothers and the financial meltdown that followed, the U.S. dollar appreciated, attracting financial flows from all over the world. As we argue in the following subsection, some countries, especially the United States, are somehow insulated

from these phenomena given the status that their currencies have in the international monetary system.

2.3.2 Currency hierarchy

Latin American structuralist authors (henceforth structuralists) make an important contribution to the post-Keynesian theory of exchange rate dynamics in DEEs. These authors emphasize the asymmetries of the international monetary and financial system (IMFS) and are known as the "currency hierarchy" school (Carneiro, 2008; De Conti et al., 2014; Prates, 2005; Ramos, 2016; Fritz et al., 2018). In a nutshell, these authors emphasize the hierarchical character of the IMFS, in which only a few currencies – called central currencies – are demanded internationally. Hence, these central currencies are liquid internationally while the rest of the currencies of the world – known as peripheral currencies – do not perform the functions of money internationally. As a consequence of this asymmetry, peripheral currencies are used as speculative financial assets by international investors and are subject to higher volatility due to the cycles of liquidity preference – or risk-appetite – in international markets. These cyclical fluctuations are mainly determined by the fundamentals of advanced economies – like the U.S. policy rate – and create cycles of booms and busts in DEEs (Biancareli, 2009).

According to Prates and Cintra (2007), the contemporaneous IMFS is characterized by a hegemony of a "flexible, financial and fiduciary" USD. It is flexible due to the absence of any fixed parity with other currencies or commodities, financial because its reserve of value status is not connected to any physical attribute but the sovereignty of the United States government and because it is the main currency used in global financial, trade and commodity markets. The bills and bonds of the U.S. Treasury, considered to be the world's safest and most liquid assets[11] and a safe haven against disorders in international markets, are the main symbol of this hegemony. Finally, the USD is also fiduciary because the U.S. government is not obliged to convert it to anything. According to Serrano (2002), this combination of factors gives a remarkable policy space to the American government since it can run persistent current account deficits without any pressure on their policy interest rate. Furthermore, they can borrow funds internationally without any default risk since their external debt is denominated in their currency. Therefore, the United States benefits from monetary sovereignty at home and in world markets (Prates, 2020).

In this system, the Fed is effectively the lender of last resort of the world markets since it is the only agent capable of providing liquidity in the safest asset in times of stress.[12] In parallel and consequently, the USD became the main "funding" currency in

[11] This preference is clear when we regard the currency composition of international reserves.

[12] The swap lines that were open with major central banks during the 2008 crisis is the perfect example of this fact. See Mehrling (2010) for a detailed analysis of the central place of the Fed in world financial markets.

global financial markets, which only reinforces the hegemony of the USD and the crucial role of the Fed. Therefore, the USD benefits from the highest liquidity premium among the world currencies (Fritz et al., 2018; Andrade and Prates, 2013; Kaltenbrunner, 2015b) and has no price-risk since it serves as the global unit of account.

The concept of liquidity is crucial for structuralist authors to develop their concept of currency hierarchy and the asymmetries of the IMFS. For De Conti et al. (2014), liquidity is the capacity of an asset to be quickly transformed in means of payment without capital losses. In a national context, central bank money is the liquid asset by excellence since it is the unit of account and a means of payment by definition. With the insurance of the central bank, bank deposits are virtually as good as cash, and are the most widely used IOU in the system. After that, there is a hierarchical sequence of IOUs – promises of payment in the future – with different degrees of liquidity (Bell, 2001; Mehrling, 2013a). Therefore, the liabilities of the central bank and of the banking system play a central role in the system. This interpretation is rooted in Minsky (1975, p. 74), who derives the "endogenous determination of the effective quantity of money" from the introduction of near monies. The diffusion of financial institutions and layers of near monies progressively increases the system's illiquidity, despite the appearance of tranquility. If not controlled, this diffusion can generate a situation in which agents end up holding significant risks of capital loss despite the apparent safety of their assets. If something triggers a fire-sale of assets in the distant layers of monies, the price of these assets could fall abruptly, generating margin calls on "safer" layers that could fall and take down even "safer" layers in a domino effect that is likely to wreak havoc in the financial system if the central bank does not intervene as a lender of last resort. This is the paradox of liquidity – the apparent expansion of liquidity through near monies implies, from a macroeconomic perspective, its effective reduction (Lavoie, 2014).

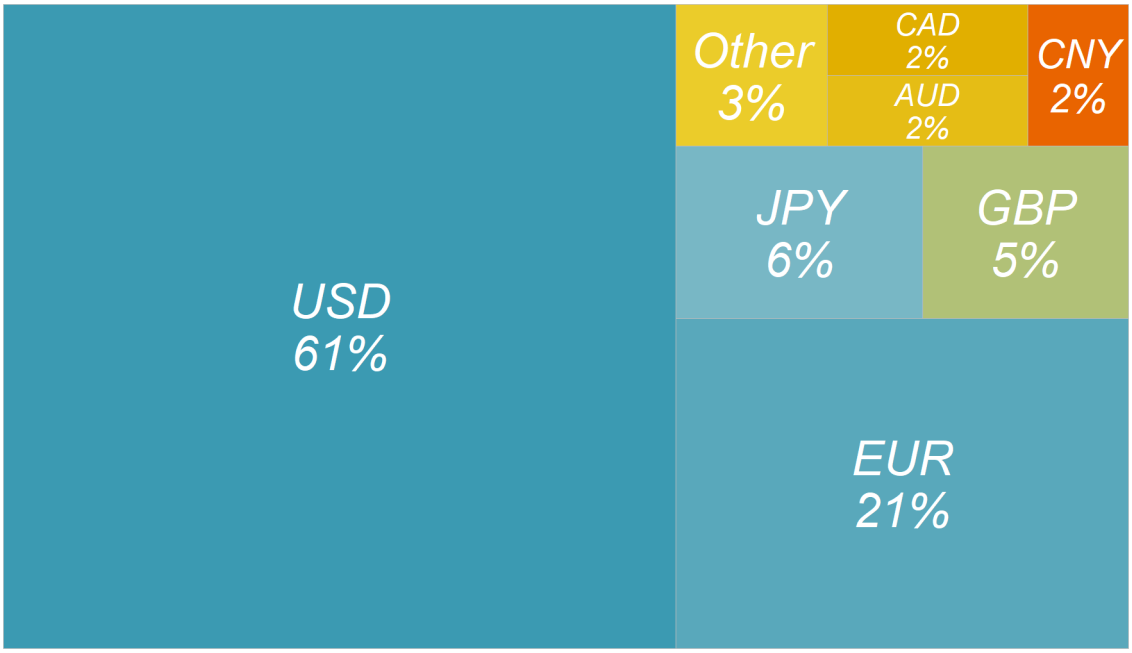
The fact that only a handful of currencies are used and accepted internationally adds an important dimension to this concept of liquidity. At the international level, the different currencies are similar to the layers of near monies in a national monetary system. The USD is the most liquid, and the currencies issued by hyperinflationary countries are the least liquid of the system since they are effectively rejected by their population. In between, there is a continuum of currencies that are sovereign in their territories and can be exchanged on exchange rate markets for other currencies but are virtually useless outside their national borders. This international liquidity is labeled by De Conti et al. (2014) as "currency liquidity." This monetary asymmetry is crucial to understand the other asymmetries in the IMFS (Fritz et al., 2018). It is important to underline that the currency liquidity depends critically on the currency's use in the international sphere, either in financial markets or for external trade. Therefore, even in floating exchange rate regimes in which the peripheral currencies can be converted to central ones in their exchange rate markets, DEEs must offer a higher premium – in the form of higher interest rates – if

they expect to have the assets denominated in their domestic currencies demanded by international investors (Carneiro, 2008; Prates, 2005).

Drawing a parallel with the "taxes drive money" approach from MMT, the international use of a currency is closely linked to its position in the currency hierarchy. The USD is the hegemonic currency since it is the most used in international financial markets, global trade, and key commodity markets like oil and gas. This international acceptability of the USD makes it the favored currency for storing value and for intervening in exchange rate markets, thereby reinforcing its key position in the system. For the rest of the currencies, their liquidity premia are connected to their capacity to settle international transactions and store value and their ability to be transformed in the reserve currency quickly and without a capital loss (Bonizzi, 2017; Kaltenbrunner, 2015b).

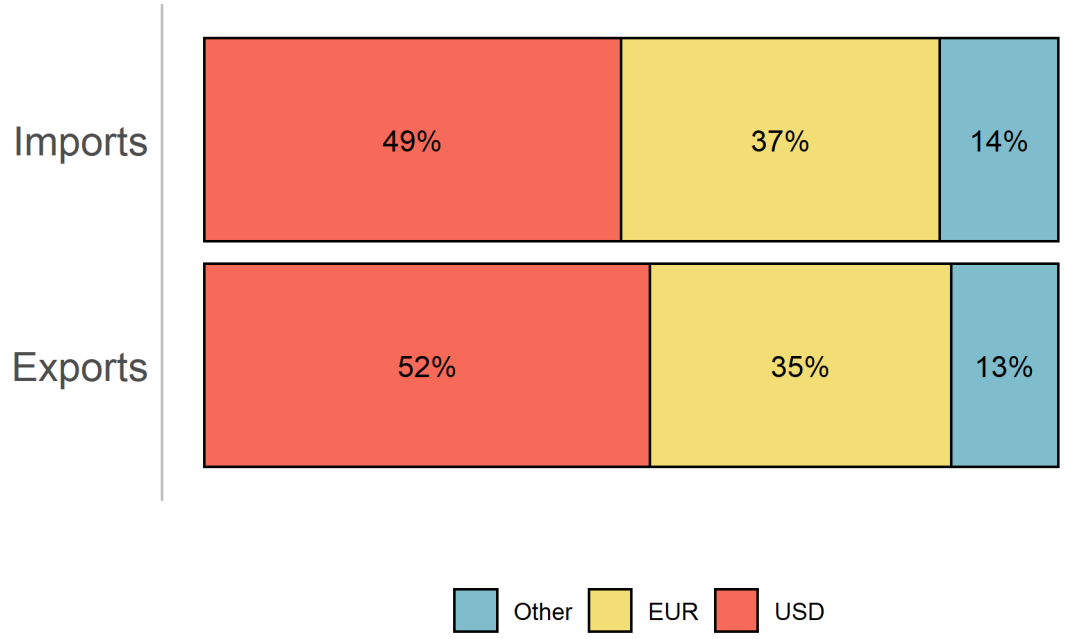
We can glimpse the hegemonic role of the USD with Figures 2.4, 2.5, 2.6, and 2.7. Figure 2.4 displays the currency composition of allocated international reserves that are released to the IMF. As we can see in this Figure, more than 60% of the total disclosed portfolios of international reserves are allocated in U.S. dollars. The Euro is the second most important currency of denomination of international reserves, denominating 21% of these reserves. Figure 2.5 displays the invoice-currencies used in global trade in 2018 based on data collected by Boz et al. (2020). These data show that the U.S. dollar and the Euro play a significant role in global trade. Nonetheless, it must be noted that intra-European trade is included in the data, which can inflate the participation of the Euro in the total, and important countries like China and Mexico are not included in the dataset – possibly downplaying the emerging role of the Chinese Renminbi.

Figure 2.4: Currency composition of allocated international reserves, 2019



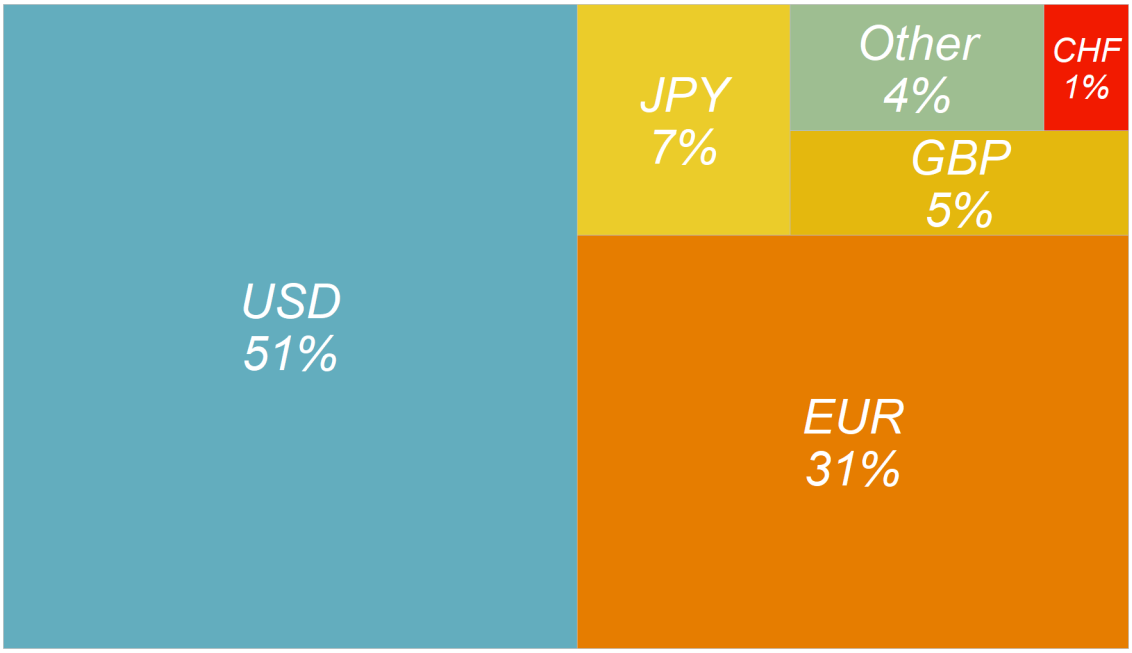
Source: IMF - COFER.
Author's elaboration.

Figure 2.5: Currency composition of world's imports and exports invoicing, 2018



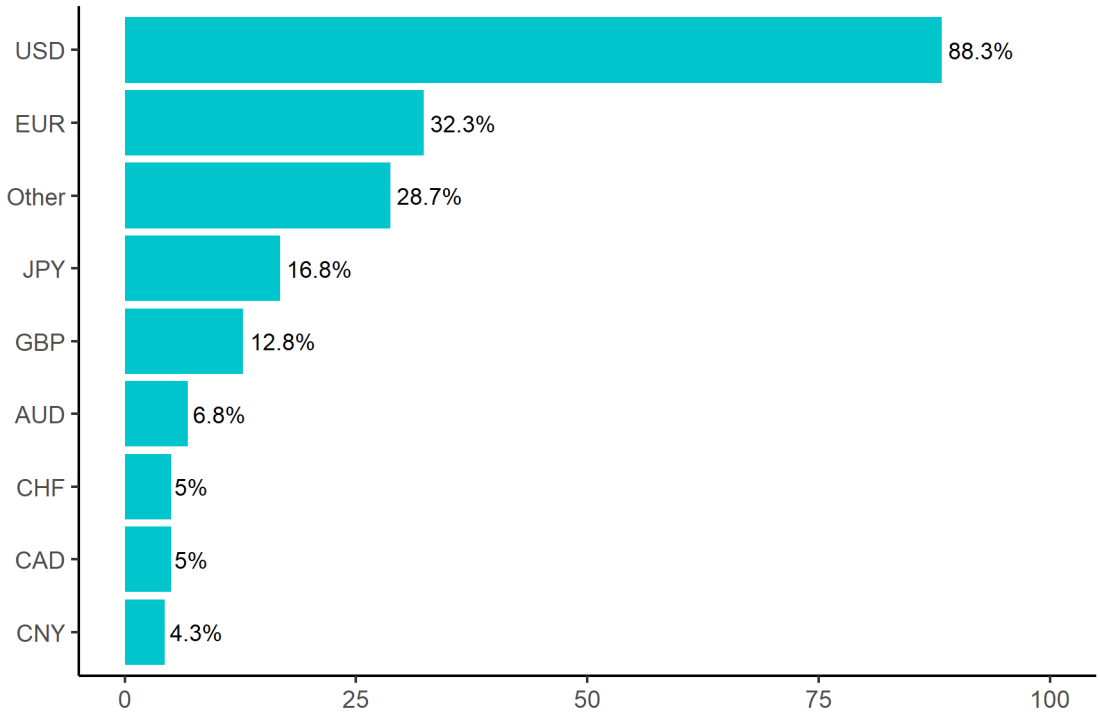
Source: Boz et al. (2020).
Author's elaboration.

Figure 2.6: Currency denomination of global banks' cross-border claims, 2020



Source: BIS - Locational statistics, Table A1.
Author's elaboration.

Figure 2.7: Currency distribution of OTC foreign exchange turnover, 2019



Source: BIS (2019).
Note: Total percentage sums to 200 since two currencies are involved in every foreign exchange transaction.
Author's elaboration.

Figures 2.6 and 2.7 illustrate the relevance of the two major currencies in global financial markets. Figure 2.6 shows the currency composition of the cross-border claims of global banks. As we can see, more than half of these claims (assets and liabilities combined) are denominated in U.S. dollars, and 31% in Euros. Finally, Figure 2.7 displays the foreign exchange market turnover by currency. These data capture the daily averages in April 2019, and shows that the U.S. dollar was in one of the sides of 88% of currency transactions (BIS, 2019). These data show that, at the time of writing, the U.S. dollar is still the unchallenged hegemonic currency in global commercial and financial markets. Based on the available data, the Chinese Renminbi still plays a minor role. However, Chinese authorities are working on the development of financial infrastructures to support the utilization of their currency, and the ambition of projects like the Belt and Road initiative led many authors to suggest that this currency has the potential to challenge the global hegemony of the U.S. dollar (De Conti et al., 2019; Faudot, 2016; Faudot and Ponsot, 2016; Guttmann, 2016). The internationalization of the Chinese Renminbi remains as an important avenue for future research.

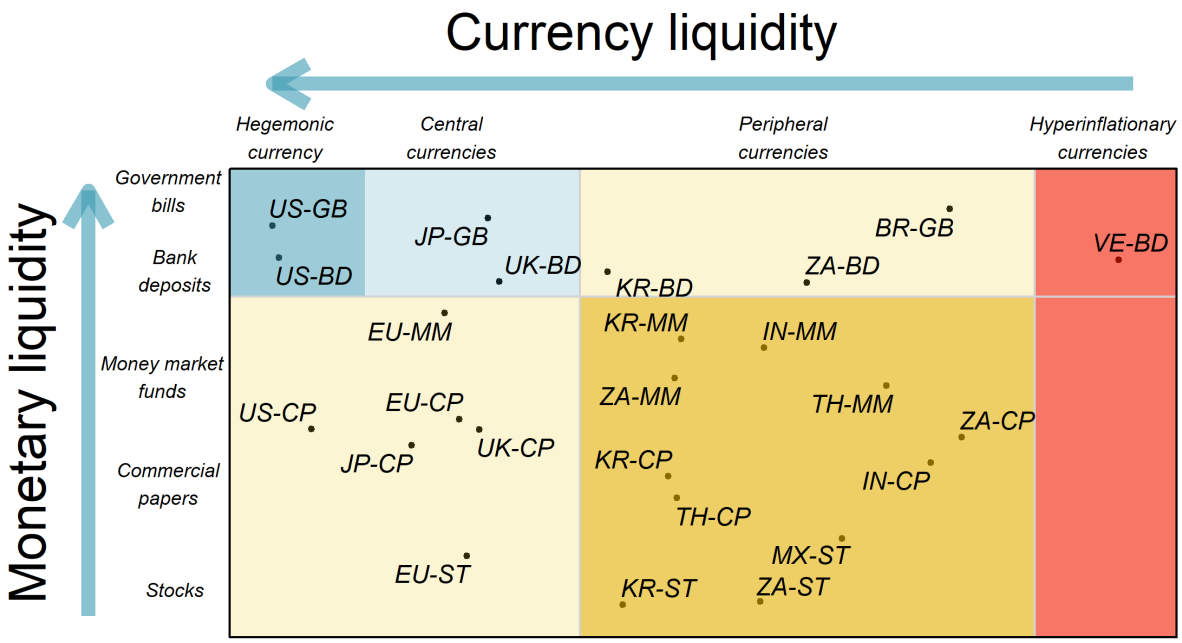
Therefore, the monetary hierarchy, understood in its national and international dimensions, is better represented by a matrix, in which the "money" hierarchy *à la* Bell (2001) and Mehrling (2013a) is in the vertical dimension, with government and central bank liabilities being the most liquid assets[13], followed closely by bank deposits, and then by other financial liabilities like money market funds, commercial papers, stocks, money and government liabilities being the most liquid assets and followed by bank liabilities and the other different layers of monies and financial assets. On the horizontal axis, we have the currency hierarchy *à la* De Conti et al. (2014) and Prates (2002) with the USD being the most the most currency liquid – i.e., the hegemonic currency –, followed by other central currencies, thee peripheral currencies, and finally the hyperinflationary currencies.[14] Figure 2.8 helps to visualize such two-dimensional scheme. At its top left, one finds in blue the most liquid assets in the system since they have both the money liquidity in the national sphere and the currency liquidity in the international sphere. U.S. government bills and bank deposits are highlighted in a darker blue to emphasize their hegemonic status. Assets that are positioned on the yellow sections of Figure 2.8 represent the different layers of near monies, and the farther they are from the top, the less "money" liquid they are. In a similar way, the horizontal dimension represents the

[13]In most central countries, there is no clear distinction between central bank and government liabilities. However, investors may prefer to hold central bank bills instead of government securities in peripheral countries due to a lack of confidence and or to pressure these governments to adopt a different set of policies.

[14]De Conti et al. (2014) classifies the EUR as a more liquid currency than the JPY, the GBP, and other central currencies used internationally but without the USD status. We prefer to include the EUR in the central currencies groups to emphasize the key role of the USD in the IMFS. Moreover, the liquidity crisis in the European banking system that followed the turmoil in the U.S. market during the 2007 and 2008 financial crisis that was ultimately solved by the swap agreements between the Fed and the ECB is an evidence of the subordinated character of the EUR in relation to the USD.

currency hierarchy and the farther the assets are to the right, the less currency liquid they are.

Figure 2.8: Monetary hierarchy



Note: Currencies in the same color-squares are analytically equivalent, and their disposition from right to left serve illustrative purposes only. The labels use *iso2c* codes to represent the countries issuing the currency on their left-hand side and the financial liability class on the right-hand side. For example, "US-GB" represents an American government bill, while "IN-CP" represents a commercial paper denominated in Indian Rupees.
Author's elaboration.

We used the same light-yellow color to represent government and central bank bills in peripheral countries to emphasize that there are considered high-yielding risky assets on the international markets. Symptoms of this fact are the absence of investment grades similar to those given to central countries and the high correlation of returns on peripheral currencies and high-yielding assets in the United States (Carneiro, 2008). A similar pattern is identified by Frenkel (2008), who characterizes this structural aspect of the world economy as "segmented integration" of peripheral countries into the world capital markets. Near-monies denominated in peripheral currencies represent the riskier acceptable assets in the system, and are depicted in the dark-yellow square of Figure 2.8. Finally, liabilities denominated in hyperinflationary currencies are virtually rejected by their own citizens. These assets are depicted in red, and there is no significant near-monies denominated in these currencies. Therefore, it should be clear that there is no such thing as perfect asset substitutability in international markets.

Finally, the absence of currency liquidity ties the demand for peripheral currencies to the international liquidity cycles. When global liquidity preference is weak and international investors are inclined to take more risks in exchange for higher returns, peripheral currencies are highly demanded, and they can be considered to be safe as central currencies. However, this demand can suddenly disappear if something happens in the international markets that trigger a flight to safety. Therefore, peripheral currencies are cyclically liquid (De Conti et al., 2014). It is the paradox of liquidity but with an international dimension.

2.3.3 Global liquidity cycles

The last few decades witnessed significant growth and deregulation of the financial sector worldwide, together with the fast development of financial products and the expansion of derivatives markets. This expansion, together with the diffusion of the short-sighted decision-making rationale of the financial markets to other sectors, is behind what some authors call the "finance-led" era of capitalism, in which decisions to spend are increasingly speculative and dominated by portfolio decisions of institutional funds that manage the ever-larger private wealth of developed and emerging economies (Braga, 2000; Epstein, 2005; Guttmann, 2016; Minsky, 1975; Morin, 2015). In this context, global financial factors and international liquidity preference have become one of the main factors behind not only the international flows of capital but also of the price of commodities – as a consequence of the higher global economic activity at the height of the cycle and of the financialization of commodities (Bastourre et al., 2010; Cibilis and Allami, 2019; Tang and Xiong, 2012) – and are crucial to understanding currency movements worldwide (Rossi, 2016).

Structuralist and post-Keynesian authors close to the currency hierarchy school argue that investors' expectations about future movements of the fundamentals of the central economies – particularly interest rates – are far more important than the fundamentals of peripheral countries in the determination of their portfolio investments in DEEs. As a consequence, the IMFS is characterized by periods of high and low availability of finance in international markets, making the availability of external financing far beyond the immediate control of DEEs authorities (Biancareli, 2007, 2009). In this context, domestic fundamentals are only important to the extent that they mitigate the consequences of sudden drains and floods of external capital. Starting from a historical analysis of the financial flows to DEEs in the last 40 years, Akyüz (2012) argues that these flows were characterized by cycles of booms and busts, in which sudden stops followed periods of financial euphoria (surges in capital flows). He notes that periods of low interest rates in the United States act as a catalyzer of financial flows by making institutional investors

search for higher yields in DEEs, placing the U.S. Federal Reserve at the center of the global financial cycle.

It is important to note that the most important decision of these institutional investors is their asset allocation due to the rigidity of their liabilities. Therefore, it is not a genuine preference for emerging markets but the profit constraint that drives them to DEEs when interest rates are low in central markets (Bonizzi, 2017). As a consequence, they often prefer flexible positions in these economies, like shares in the stock market and public bonds, that could be reversed if the global conditions ask for cashing out these positions and rebalancing their portfolios towards their home economies. Therefore, even if they invest in locally denominated assets, their investments constitute a contingent liability in foreign currency as they can be quickly liquidated, generating sudden pressures in the foreign exchange markets (Kaltenbrunner, 2015a). The rise of carry trade operations reinforces this cyclical behavior – a speculative financial strategy executed generally through derivatives markets in which investors borrow low-interest currencies and invest into high-interest-rate currencies. The profitability of these operations depends on the currency movements of the target countries, and its success is a clear violation of the uncovered interest parity hypothesis (BIS, 2015; Rossi, 2016).

Akyüz (2012) also notes the concomitant movement between the global liquidity cycle, the price of commodities, and the effective nominal exchange rate of the USD versus other currencies. According to the author:

> "the parallel movements in capital flows, commodity prices, and the dollar are driven not only by such common influences as market assessments of risks and return and global liquidity conditions. They are also directly linked to one another. A weaker dollar often leads to higher commodity prices because, *ceteris paribus*, it raises global demand by lowering the non-dollar prices of commodities. Moreover, changes in commodity prices have a strong influence on investments in commodity-rich DEEs" (Akyüz, 2012, p. 76)

Nowadays, the existence of this global liquidity cycle is widely recognized (Borio, 2019; Bundesbank, 2017; Rey, 2013, 2016; Shin, 2016). In line with the post-Keynesian arguments presented in this section, Rey argues that the monetary policy stance of the Fed leads a "global financial cycle" that constrains monetary policy in financially open DEEs, regardless of their exchange rate regimes. These cycles are transmitted to DEEs through two mechanisms: the "credit channel" through which financial flows are associated with asset-price inflation that increases the value of credit collateral and stimulates credit creation through the wealth effect; and the "risk-taking channel" arising from procyclical creditworthiness assessments. If the Fed decides to increase its interest rates, the reverse will happen. Therefore, exchange rate movements in DEEs would not be an answer to the productive disequilibria reflected in their current account balances but to the interest rate differential between these economies.

On the other hand, Shin (2016) emphasizes the crucial role of the USD in the global banking system. He underlines the centrality of the USD in hedging markets for almost every currency, becoming the most important financial-vehicle international currency. This is related to the role of international banks in these markets and to the fact that they cover their exposition in USD with USD-denominated assets. Hence, it is cheaper for banks to cover their positions when the USD is depreciating, allowing them to ease credit conditions in international markets and transmitting the monetary stance of the U.S. to the rest of the globe. Therefore, the "value of the dollar is a barometer of risk-taking and global credit conditions ... a weaker dollar is associated with greater lending in dollars, lower volatility and more risk-taking, but a stronger dollar is associated with higher volatility and a recoiling from risk-taking" (Ibid., p. 9). Ghosh et al. (2012) present empirical evidence that inflows of capital originated by nonresidents are the main factor responsible for capital surges in DEEs and that these flows are sensitive to global risk factors like the VIX and also to the U.S. policy rate. Therefore, they concludes that global factors "open the gates" of international flows.

We explore the relationship between the global liquidity cycles and the currency movements in DEEs in chapter 3. This chapter presents empirical evidence of an asymmetric relationship between the global liquidity cycle variables and the exchange rate market pressure in a panel of 25 DEEs. Descriptive statistics and stylized facts about the global liquidity cycle are only presented in that chapter. Briefly, in section 3.2.1 of that chapter, we present data that corroborates the literature mentioned in this subsection and suggests that one important feature of the global liquidity cycles in the last 20 years is the synchronization of the movements of peripheral exchange rates, regardless of their macroeconomic fundamentals due to the existence of these common global factors.

2.3.4 Dutch disease and the new developmentalist school

New developmentalist authors – a school that is also associated with post-Keynesians and Latin American structuralists (Berr and Bresser-Pereira, 2018) – place significant emphasis on a structural feature of the world economy that would affect middle-income countries with an abundance of natural resources and drive their exchange rates if market forces are left unfettered: the Dutch disease.[15] The origin of the term is associated with the negative effects on the manufacturing sector of the Netherlands brought about by the real appreciation of the guilder as a consequence of the discovery of gas reserves in the 1960s. Although attempts to theoretically formalize this phenomenon exist at least since Corden and Neary (1982), we will focus mainly on the new developmentalist interpretation of it, which has the works of Bresser-Pereira (2008, 2010, among others) as its main reference.

[15]Bresser-Pereira is careful in distinguishing the Dutch disease, which has strict economic reasons, to the resource-curse, a concept connected to corruption and rent-seeking associated with the exploration of natural resources. We only deal with the former in this work.

For the new developmentalists, the Dutch disease is a market failure in countries with abundant and cheap natural resources and in which the costs involved in their production are particularly low and below the cost of production of its international competitors. The exploitation of natural resources under these conditions generates Ricardian rents in these sectors (Bresser-Pereira, 2010). Guzman et al. (2018) make a similar argument. For them, market forces in the presence of abundant and cheap natural resources will lead to a suboptimal allocation of resources on tradable sectors with large learning spillovers, constituting a market-failure that must be corrected with active policies.

To understand the impact of the Dutch disease on foreign exchange markets, we have to keep in mind that it is a real phenomenon. Hence, its effects are better understood if we ignore the effect of financial flows and government interventions and suppose an economy that is only open to commercial flows. As in any economy, the exchange rate will be determined by the supply and demand for foreign currencies. Given the abundance of natural resources and the steady global demand for them, the commercialization of these goods will dominate this country's exports. The resulting exchange rate will reflect the commodities sector's production costs and will be therefore lower[16] than necessary to make the manufacturing sector of this economy competitive. It is from this insight that new developmentalist authors argue that there are two equilibrium exchange rates in an economy that suffers from the Dutch disease: the "current" equilibrium exchange rate, which reflects the production costs of the natural resources sector; and the "industrial" equilibrium exchange rate, that makes the manufacturing and other non-traditional tradable sectors competitive in international markets given a certain technological gap (Oreiro, 2020). The two equilibrium exchange rates are central to the structuralist theory of the Dutch disease. First, it serves as a measure of the disease: the higher the ratio between the industrial exchange rate and the current equilibrium exchange rate, the more severe the Dutch disease is. Secondly, the two exchange rates theoretically explain how a country can have an inter-temporally balanced current account and an overappreciated exchange rate at the same time (Bresser-Pereira, 2010, 2018). Oreiro (2020) formalize these arguments, showing that a real exchange rate at the industrial equilibrium level can stimulate exports and thereby the investment in the economy. This process, if attached to an effective industrial policy, can promote the development of modern production techniques, igniting a virtuous cycle that can surpass the capacity and balance-of-payments constraints that hindered the processes of economic growth in Latin America.

It is important to remark that the profitability of manufacturing sectors in countries that fail to neutralize the Dutch disease will be structurally attached to the price of commodities in international markets. Since the production costs associated with the commodities sector are relatively stable, the profitability of these sectors increases together with commodity prices, augmenting the difference between the two equilibrium exchange

[16]The exchange rate here is defined as the price of a foreign currency in terms of the domestic currency.

rates. Therefore, the severity of the Dutch disease is higher when commodity prices are higher, diminishing the incentives to invest in manufacturing sectors. In this sense, the severity of the Dutch disease is cyclical and independent of domestic factors. This point is connected with the recent literature that emphasizes the growing financialization of commodities markets that are increasingly dominated by institutional investors. Since most of these investors are not interested in holding physical assets, they tend to invest in the commodities' derivatives markets. Consequently, these markets have become the locus of the determination[17] of commodities prices[18] (Ventimiglia, 2012; Wray, 2008). The financialization of the commodities markets also led to a higher correlation between different commodities and between these prices and financial indices of emerging markets (Tang and Xiong, 2012).

Therefore, the Dutch disease, which is usually considered a real phenomenon, should be understood in its cyclical and financialized dimension as well. It is a structural phenomenon that, together with the cyclical liquidity premia of DEEs currencies, is behind the tendency of cyclical overvaluation and depreciation of the exchange rates in these countries (Bresser-Pereira, 2010; Palma, 2005).

2.3.5 A structuralist post-Keynesian and Minskyan interpretation of exchange rate cycles in Developing and Emerging Economies

The cyclical nature of the exchange rate in DEEs open to financial globalization, which follows a pattern of protracted appreciations followed by sharp depreciation, inspired several Minskyan interpretations among post-Keynesians. While the first (Arestis and Glickman, 2002; Boyer et al., 2004; Kregel, 2001) and the second (Bonizzi, 2017; De Conti et al., 2013a; Kaltenbrunner, 2015b; Médici, 2020; Ramos, 2019) generations of Minskyan approaches to financial crisis and exchange rates in DEEs are closer to the currency hierarchy school and emphasize the role of financial flows – driven by external debt or by institutional investors' portfolio decisions, respectively – new developmentalist authors also rely on a Minskyan framework to explain the tendency toward overvaluation of DEEs currencies (Bresser-Pereira et al., 2008). This subsection aims to show that these approaches are complementary and provide the elements for a synthesis of the structuralist post-Keynesian analysis of the exchange rate cycles in DEEs.

[17] The importance of derivatives markets in the determination of spot prices is not at all bounded to commodities markets and are becoming increasingly paramount in the financialized capitalism (Carneiro et al., 2015).

[18] Although the relevance of the narrowly defined financial determination of commodity prices are debatable (Christiano and Chari, 2017), easy credit conditions worldwide tend to increase global production and thereby the global demand for commodities, adding a real pressure to the prices (see Bastourre et al. (2010) for a discussion of the topic).

As we argued previously in subsection 2.3.1, the basic post-Keynesian framework underlines the role of financial flows on the short-run determination of the exchange rate and the importance of current account balances in the medium to long run. In this interpretation, financial flows depend on market expectations in a context of radical uncertainty (Harvey, 2009; Lavoie, 2014; Moosa, 2002). These authors distinguish between two ideal market participants: "chartists" (speculators) and "fundamentalists." The former are typically trend chasers, while the latter guide their investment decisions by macroeconomic fundamentals. In this framework, speculation can exacerbate short-run movements of the exchange rate, but current account balances work as a gravitational center in the medium and long run (Lavoie, 2014). This framework is a useful starting point to understand the exchange rate cycles in DEEs, but it must be complemented. In particular, the ratio of international to local investors is substantial in DEEs, making nonresidents' portfolio decisions the main light-house of market expectations. However, specific peripheral assets are not the main assets of their portfolio and are classified together with other risky assets, being first in line to be liquidated in the case of necessity (Prates, 2002, 2005). Therefore, an important characteristic of DEEs markets is that the most important "fundamentalist" investors are nonresidents who care more about the fundamentals of central economies (i.e., the liquidity cycle, which includes global interest rates and commodity prices) than about the macroeconomic fundamentals of the countries in which they are investing.

According to Ramos (2019), one characteristic of the financialization in DEEs is that money managers have risen to the center of the exchange rate developments in these countries. The fact that their liabilities are funded in developed markets while their investments are spread between developed and emerging economies accentuates the connection between these markets through these investors' balance-sheets. The boom phase of the cycle starts with easier credit conditions worldwide and growing commodity prices, increasing the profitability of investments in DEEs and triggering cross-border financial flows to these economies (Aliber and Kindleberger, 2015). These conditions also lead to higher commodity prices, increasing the profitability of the natural resources sectors in DEEs and increase the supply of foreign currency to the country through commercial flows, appreciating the exchange rate. Here, the first structural cause of the tendency toward overvaluation of the exchange rate comes into play as the current equilibrium exchange rate starts moving away from the industrial equilibrium exchange rate – increasing the severity of the Dutch disease. This process also increases the perceived currency liquidity of peripheral currencies – the second structural cause of the tendency toward overvaluation – augmenting its expected profitability[19] and attracting financial flows. Together, these processes culminate in the appreciation of the domestic currency, easier local financial conditions, and inflation of asset prices. These movements reinforce each other like

[19]Corrected by the liquidity differential. This concept is important because it allows the effective interest rate differential to increase even if the nominal interest rate differential is falling.

a financial accelerator, which is also reflected in higher relative prices of non-tradables in the domestic market as the economy moves towards higher employment rates (Aliber and Kindleberger, 2015; Blanchard et al., 2017; De Gregorio, 2010).

However, these developments create a policy dilemma, known as the Tosovsky dilemma in the mainstream literature, since central bankers usually would want to increase interest rates to control inflation, but it would attract further financial inflows, causing a real exchange rate appreciation, which would feed the financial accelerator again and undermine the monetary policy intervention (Lipschitz et al., 2002; Na, 2018). With its focus on consumer-price stability, the conventional orthodox solution is to raise interest rates regardless of their impact on financial flows, allowing the exchange rate appreciation to help control the price of tradable goods, keeping consumer-price inflation in check. This is achieved at the expense of a more severe Dutch disease and the displacement of local production for imported goods, turning the current account balance into a negative position. The presumed capital scarcity theoretically justifies this in DEEs, but in reality, it generally leads to the substitution of foreign savings for domestic savings, keeping the investment rate constant (Gala et al., 2011).[20] At this phase of the cycle, financial inflows can take the form of external debt in foreign currency, which also exacerbates the problem of currency mismatches, or can be driven by financial and direct investments in search for higher returns. In this context, carry trade operations[21] are particularly destabilizing (De Conti et al., 2013a; Rossi, 2016).

These developments ignite a feedback mechanism of self-fulfilling expectations on investments on DEEs' currencies and assets, which leads to further increases in the price of these assets and currencies (Orléan, 2004; Plihon, 2010; Ramos, 2019; Soros, 2013). The apparent success of monetary policy in controlling prices conceals the deterioration of the external accounts of these economies and covers the buildup of financial fragilities at the domestic macroeconomic level. Stability breeds instability. Left to market forces, the current account deficit tends to rise in this situation, and in many cases, the commercial flows also become more dependent on inflated commodity prices, increasing the external fragility of the economy. Simultaneously, the higher exposure of international investors to DEEs currencies increases the riskiness of their positions. The main source of the speculative profits of nonresidents investing in DEEs is the combination of exchange rate variation with the interest rate differential between these and the core economies. Given the international currency hierarchy, the interest rate differential is structurally positive. Therefore, the exchange rate variation is the riskier variable. When the DEEs' currencies are appreciating, these investors realize a double gain. But when they depreciate, speculative profits can be quickly erased. With the balance sheets of

[20] See Gala et al. (2011) for a theoretical explanation and empirical evidence of this "savings displacement."

[21] See BIS (2015); Brunnermeier et al. (2009); Rossi (2016) for a detailed analysis of carry trade operations.

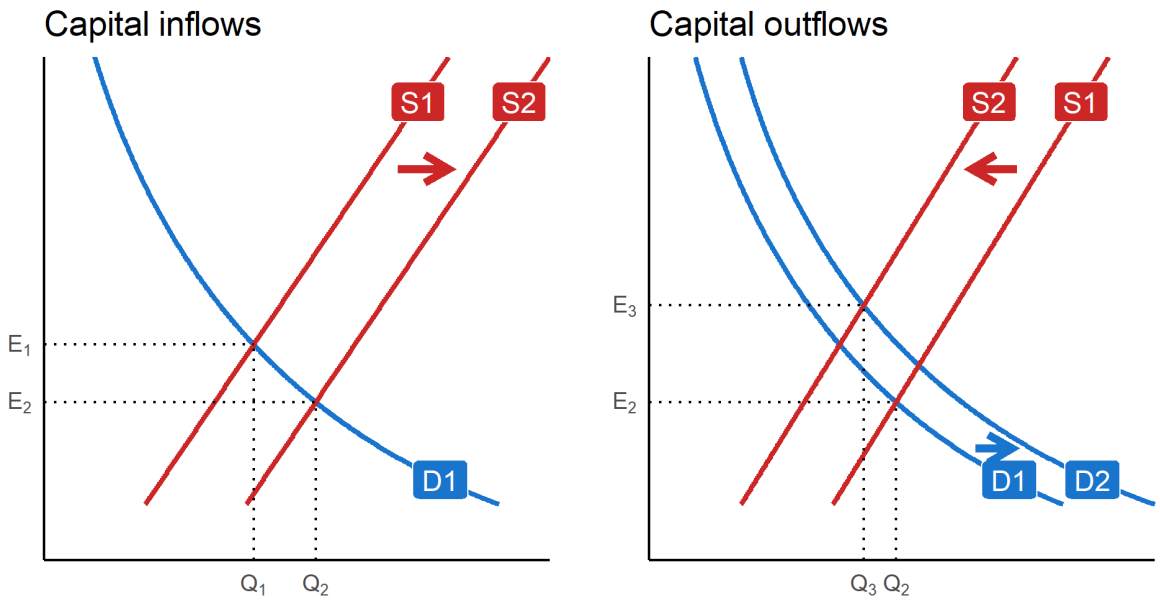
international investors becoming increasingly riskier, an event that would not be unusual under different circumstances (e.g., the signaling of a different monetary policy stance in the advanced economies) can trigger a fire-sale of assets in target currencies and create an "asset-exchange-rate deflation" spiral (Ramos, 2019, p. 17). Those investors that leave first are the ones that will best avoid financial losses, which explains the stampede to the exit. This movement is further amplified if the speculative operations are taken in the leveraged derivatives markets, which makes the downturn of the cycle a moment of the rapid dismantling of positions and capital flights from these markets (De Conti et al., 2013a).

These structural features are behind the perverse combination of appreciating exchange rates and increasing current account deficits that can last for long periods in DEEs. When the financial cycle moves to its downturn phase, the expected interest rate gains – adjusted for the higher liquidity premium on these currencies – fall, together with the price of commodities, and institutional investors start to reallocate their portfolios. These movements decrease the demand for DEE currencies, leading to their depreciation. At this point, the agents operating in the global financial markets know that it is unlikely that the surplus countries will bear the adjustment, and so it is almost certain that the adjustment will fall over deficit countries' shoulders, which trigger speculative attacks against them. As Davidson (2006) argues:

> "Under any conventional exchange rate system (whether it be fixed – even under a gold standard – or a flexible rate system), the conventional wisdom is that when a persistent deficit in the balance of payments occurs or is contractually imminent, then it is the deficit nation that *must* take all the remedial action for it will otherwise run out of international liquidity. The nation experiencing a persistent international payments surplus is under no pressure to alleviate this international payments imbalance even though it has the liquidity and therefore the wherewithal to do so. The conventional wisdom 'knows' that the deficit nation does not have the liquidity to withstand a speculative attack – and that the surplus nation, being under no pressure, will not alleviate its trading partner's liquidity problem. These circumstances provide the conditions that make the free one-way bet possible." (Davidson, 1999, p. 290-291, emphasis in the original)

Therefore, structuralist post-Keynesians argue that, in DEEs, it is very likely that countries running a sizeable current account deficit will experience some significant exchange rate adjustment in the downturn of the global liquidity cycles.

Figure 2.9: Effect of capital inflows followed by capital outflows in foreign exchange markets



Author's elaboration.

Furthermore, the structuralist post-Keynesian cycle in DEEs is asymmetrical: the appreciation of the currencies is slow but persistent until a reversion of the liquidity cycle triggers an often abrupt depreciation. As Soros (2013, p. 323) argues, "[b]oom-bust processes tend to be asymmetrical: booms are slow to develop and take a long time to become unsustainable, busts tend to be more abrupt, due to forced liquidation of unsustainable positions and the asymmetries introduced by leverage." There is another asymmetric aspect that is seldom analyzed but important to understand why the reversal of the liquidity cycle can have such an abrupt impact on the exchange rates of DEEs. As we discussed previously, an exogenous increase in capital inflows shifts the supply curve of foreign currency to the right, as shown in the first diagram in Figure 2.9, while the demand curve remains the same. The exchange rate that equilibrates the market with capital flows is at the E2 level in the diagram. If something triggers a capital flight from the country, it means not only that portfolio investors will stop supplying foreign currencies to the market, thereby shifting the supply curve to the left, but that they will start to demand foreign currencies in the market. Therefore, in the reversal of the cycle, the exchange rate settles at the E3 level, which is higher than the initial E1 level. The empirical strategy that we adopt in the chapter 3 aims to capture this type of asymmetry.

2.4 Post-Keynesian theories of exchange rate interventions

The objective of this section is to review the post-Keynesian literature that deals with foreign exchange interventions. We focus on market interventions, i.e., when the central bank buys or sells a foreign currency or a derivative in the FX derivatives markets. Although some central economies regularly intervene in their foreign exchange markets (e.g., Switzerland and Japan), most of the literature reviewed in this chapter deals with developing and emerging economies. Furthermore, the post-Keynesian literature on the topic is relatively scattered among different authors, and the mainstream division between precautionary and mercantilist demand for reserves is usually taken as a starting point to discuss these interventions. Therefore, the section is divided into four subsections, starting with a review of the mainstream literature, which serves as a background to understand the post-Keynesians views. The following sections discuss the post-Keynesian literature. We identify two distinct groups of post-Keynesians: the advocates of Modern Monetary Theory (MMT) and structuralist post-Keynesians. The former emphasize the stabilizing effects of floating exchange rate regimes, downplaying the relevance of exchange rate policies – given that the country is monetarily sovereign.

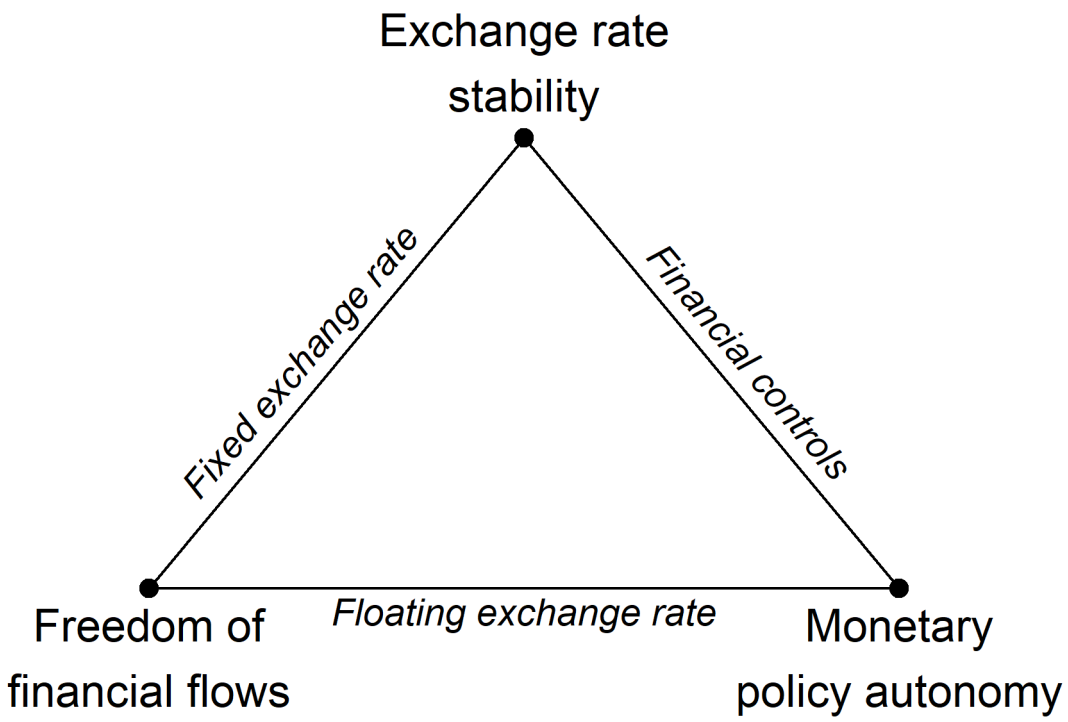
On the other hand, structuralist post-Keynesians emphasize the importance of precautionary policies in countries that are lower in the international currency hierarchy, subject to the fluctuations of the global liquidity cycle, and the importance of competitive exchange rates for long-run development. This last point, raised mainly by new developmentalist authors, is strongly criticized by Latin American Sraffians. We review this critique in detail, as we think its point against the sole utilization of exchange rate policies to foster industrial development is well-founded. However, the critique does not make any proposition, giving the impression that these authors neglect the context of persistent current account deficits implicit in new developmentalist ideas. In this situation, if policymakers do not take active steps to achieve a more competitive exchange rate that targets a more balanced current account, the exchange rate depreciation will arrive sooner or later when the reversal of the global liquidity cycle occurs. The key aspect here is that policymakers have more policy space to deal with the problems of a depreciation if they are leading the process than when the depreciation is forced upon them by the markets.

2.4.1 Mainstream

2.4.1.1 The monetary trilemma

To understand the position of mainstream authors regarding foreign exchange interventions, we must start the analysis with a brief review of the monetary or macroeconomic trilemma (also known as the impossible trinity) since it is the starting point of mainstream analyses (Frankel, 1999; Obstfeld and Taylor, 2003). The main idea behind the trilemma is that it is impossible for an economy to achieve, at the same time, three simultaneous objectives: freedom of financial flows, exchange rate stability, and monetary policy autonomy. Figure 2.10, adapted from Krugman et al. (2018, p. 589), illustrates the trilemma:

Figure 2.10: Monetary trilemma



Author's elaboration based on Krugman et al. (2018, p. 589).

Based on this trilemma, mainstream authors argue that fixed exchange rates and free capital flows can only be achieved in a country if it abandons its monetary policy autonomy. Similarly, if the country decides to have monetary policy autonomy with exchange rate stability, it must give up the freedom of financial flows. Finally, if the country chooses to have monetary policy autonomy and capital flows, it must give up exchange rate stability. Since capital controls were considered ineffective by mainstream authors until recently (Ostry et al., 2016; Reinhart and Calvo, 2000), the common view in the 1990s was that DEEs had only two sustainable policy options: hard pegs (like

currency boards or dollarized regimes) or floating exchange rates.[22] This is the "bipolar view" (DeRosa, 2009; Fischer, 2001a, 2008). These authors argued that countries would abandon their parities without strong institutional commitments to defend a particular peg in times of stress. This interpretation was inspired by the observation that many DEEs in the 1980s and early 1990s were reluctant to increase their base interest rates to avoid the contractionary effects that it would have on their economies. Under these circumstances, speculators bet against these currencies, predicting that they will fold, which would generate a self-fulfilling prophecy. Therefore, these authors considered that adjustable pegs and soft exchange rate bands were unsustainable, while currency boards would intimidate speculators.

This positive view was based on the Argentinean experience in the first half of the 1990s where the currency board was considered the key policy decision to eradicate the hyperinflation in that country (see, for instance, Fischer (2001b); Frankel (1999); Reinhart and Calvo (2000)). However, the spectacular Argentinean crisis in 2002 shattered the popularity of currency boards. Nowadays, hard pegs are considered useful only in small open economies that are very dependent on a single big commercial partner (DeRosa, 2009), while countries with reasonably developed financial markets and integrated into the global markets should follow a combination of a floating exchange rate regime with a monetary policy framework like inflation-targeting (IT) (Fischer, 2008). Taylor (2000, p. 3), for instance, argues that "the only sound monetary policy is one based on the trinity of a flexible exchange rate, an inflation target, and a monetary policy rule" in DEEs that choose not to fix their exchange rates permanently. Therefore, at a basic level, foreign exchange rate interventions would only be necessary for fixed exchange regimes where the nominal exchange rate becomes the operational target of the central bank, while floating exchange rate regime would require minimal intervention in foreign exchange markets (Stone et al., 2009).[23]

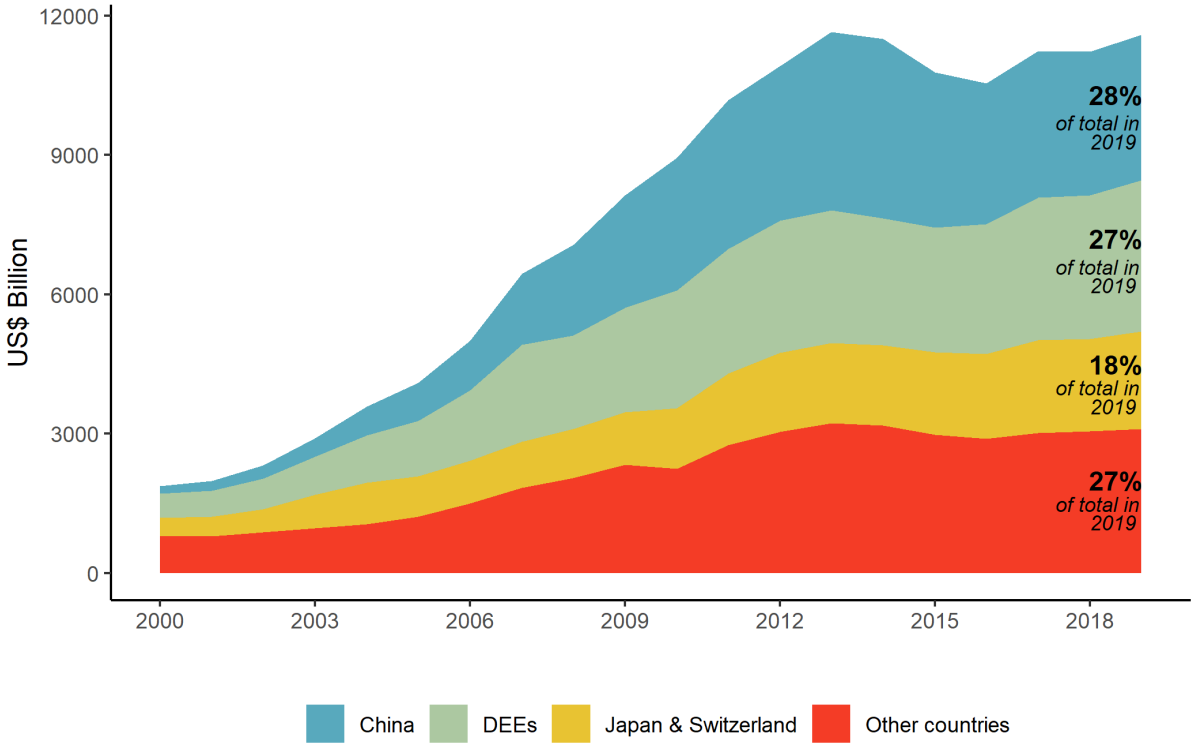
However, the 2000s and 2010s witnessed an unprecedented accumulation of international reserves in the DEEs, as can be seen in Figure 2.11, and the utilization of these reserves or derivatives instruments to deal with pressures in the foreign exchange markets (Chamon and Magud, 2019). The accumulation of reserves is explained by either a precautionary demand for reserves – aimed at preserving financial stability –, or by

[22] An important exception to this analysis is the work of Frankel (1999). For this author, the crisis would happen regardless of the exchange rate regime due to fragilities in the DEEs in the 1990s. He claims that if the DEEs in the 1990s had been floaters, they would most likely have experienced an appreciation of their exchange rates prior to the crisis, with even larger current account deficits, probably leading to a more intense crisis. In his words: "the rejection of the middle ground is then explained simply as a rejection of where most countries have been, with no reasonable expectation that the dreamed-of-sanctuaries, monetary union or free floating, will in fact be any better. The grass is always greener on the other side of the parity" (Frankel, 1999, p. 9)

[23] Less than three interventions in the last six months accordingly to the IMF (2018a) definition.

neo-mercantilist demand for reserves – aimed at preserving the external competitivity of the economy. It is to understand these arguments that we turn next.

Figure 2.11: Evolution of world's international reserves, 2000-2019



Source: World Bank.
Author's elaboration.

2.4.1.2 Precautionary demand for reserves

The DEEs crisis of the 1990s triggered an important debate about its causes among mainstream authors. First, there was wide recognition of the dangers of sudden stops of capital flows (Calvo, 1998; Reinhart and Calvo, 2000). For these authors, the sudden interruption of capital inflows to a country would generate a real exchange rate devaluation characterized by the fall in the relative price of non-tradable goods in relation to tradable goods. This process would affect the economy through two channels: a "Keynesian" channel through which a fall in aggregate demand combined with sticky wages would lead to a fall in output and employment; and a "Fischerian" channel through which the real currency depreciation would increase the interest burden of the non-tradable sectors.

The effects of sudden stops on capital flows were particularly severe when they led to the rupture of currency pegs in countries that presented currency mismatches. According to Eichengreen et al. (2007, p. 130), a currency mismatch can be defined as "differences in the values of the foreign currency-denominated assets and liabilities on the balance sheets of households, firms, the government, and the economy as a whole." As Goldstein and Turner (2004) show, there is empirical evidence of the importance of currency mismatches

in the DEEs crisis of the 1990s. They show that currency mismatches not only increased the chance of a financial crisis but also magnified the costs of getting out of one. Currency mismatches also undermine the effectiveness of monetary policies during a crisis. Given the negative patrimonial effect that currency depreciation has on the economy, the central bank is obliged to increase the policy rate instead of reducing it in order to stabilize the exchange rate, amplifying the crisis (Kaminsky et al., 2005). Moreover, Hausmann et al. (2001) find evidence that currency mismatches are more important than the exchange rate pass-through to prices to explain the general "fear of floating" behavior presented in DEEs. As a consequence, currency mismatches would undermine the operation of inflation targeting regimes by shifting the nominal anchor of monetary policy from inflation to the exchange rate.

The second important debate inside the mainstream literature is related to the causes of the excessive external indebtedness of DEEs. On the one hand, authors like Reinhart et al. (2003) argued that some DEEs suffer from "debt intolerance." They argue that countries with this condition face a threshold of external debt – usually much lower than in advanced countries[24] – that would precipitate an external crisis and sudden stop of capital inflows. These authors emphasize that it is the institutional failings of a country – especially its history of high inflation and defaults on the external debt – that causes debt intolerance. According to this interpretation, the weak institutions of these countries constrain their access to international capital markets.[25] As a consequence, policymakers must handle low levels of external debt and undertake structural measures to curb budget deficits to overcome debt intolerance.

On the other hand, Eichengreen et al. (2007, p. 122) advance the concept of "original sin," defined as "the inability of a country to borrow abroad in its own currency." Contrary to the debt intolerance approach, these authors argue that factors beyond the control of individual countries like transaction costs related to the currency diversification of portfolios are the main causes of limited access to international capital markets. These authors provide empirical evidence supporting their claim that DEEs with different macroeconomic and institutional trajectories faced similar constraints in international capital markets.[26]

These theories are behind the acceptance by mainstream authors of the accumulation of international reserves by DEEs to avoid currency mismatches and preserve financial stability in the economy, even in floating exchange rate regimes. This type of demand is known as the "precautionary" demand for reserves. For example, Fischer (2001b) argued in his opening remarks at the IMF and World Bank joint forum about international

[24] Around 25% of the GDP.

[25] This position is shared by Goldstein (2002).

[26] It is important to note that they do not dismiss domestic policies and institutions as irrelevant. They just argue that they are not the main cause behind the inability of DEEs to borrow externally in their own currency.

reserves in the aftermath of the 1990s turmoil that crisis prevention became the most important motive for demanding international reserves. According to this author, this is especially true for DEEs open to international capital flows. Furthermore, he noted that countries with higher reserves did better during the 1990s crisis and suggested that these countries follow the "Greenspan-Guidotti" rule and hold a level of international reserves that is at least enough to cover the short-term external debt of the country. After that, the IMF endorsed the accumulation of international reserves to prevent financial crises (Dhar, 2012). Therefore, according to mainstream authors, financial stability considerations are the main reason for hoarding reserves (Dorrucci, Ettore et al., 2006; Ghosh et al., 2012).

Despite the endorsement of larger foreign reserves from multilateral institutions in the 2000s, Rodrik (2006) argues that one consequence of the 1990s crisis was the wide recognition among DEEs' policymakers that they could not rely on multilateral institutions to help them during financial and balance of payments crises. Moreover, going to these institutions for help was deemed to give a bad reputation given the conditionalities imposed together with the Fund's help. That was the case because many DEEs were affected by the 1990s crisis regardless of the "sound" macroeconomic policies suggested by these institutions. Therefore, DEEs policymakers concluded that they could only rely on their foreign currency reserves to bridge external liquidity shortages (Rodrik, 2006). The acceleration of the hoarding of international reserves in the 2000s must be understood in this context. Rodrik (2006) also argues that the accumulation of international reserves was a market-friendly strategy adopted by DEEs to join the global financial markets without facing the dangers of sudden stops and currency mismatches. In a similar vein, Aizenman (2008) and Aizenman and Lee (2007) argue that foreign exchange reserves are like insurance for these countries, allowing their central banks to act as "lender of last resort" in foreign currency, reducing the output costs of sudden stops. Jeanne and Ranciere (2006, 2011) formalize these arguments in an insurance model and propose a measurement of the optimal level of reserves based on external debt and the possibility of a sudden stop.

Obstfeld et al. (2010) extend the previous formalizations and evaluate the adequacy of reserves not only in relation to the external debt, analyzing different sources of financial instability. For these authors, the financial openness and the size of domestic financial markets in the country should be considered when assessing the adequacy of international reserves since sudden outflows of resident-capital could be as harmful as sudden stops of inflows to the economy. Furthermore, if these outflows trigger a bank run, they could generate a twin crisis in which the external liquidity shortage is matched at home with a banking crisis. The authorities would face several constraints in this situation since any attempt to rescue the banking sector by acting as the lender of last resort could undermine their efforts to stabilize the exchange rate. These considerations were incorporated into the official IMF recommendation to DEEs summarized in the "assessing reserve adequacy" reports (IMF, 2011, 2013, 2015). In these reports, the IMF proposes a new adequacy

metric that incorporates the current account risks (measured by the level of exports); the size of the country's M2 to capture the risks of capital outflows; the short-term external indebtedness in order to measure possible problems in renewing the contracts; and finally, the external portfolio liabilities that capture other possible sources of capital outflows. The crisis of 2008 vindicated the precautionary demand for reserves. Bussiere et al. (2013), for example, present evidence that the accumulation of reserves before the crisis was positively related to the output growth during the crisis and in its aftermath. For these authors, international reserves are like a "nuclear weapon" since they show the robustness of the country's defenses and serve as a deterrent to speculative attacks. Furthermore, reserves were also used as "gunpowder," enabling some DEEs to provide liquidity in foreign currency in their markets during the worst phase of the financial crisis. The authors also show evidence that the stocks of reserves were quickly rebuilt after the period of intense financial stress between September 2008 and February 2009.[27] The IEO (2012) report emphasizes that this was the common perception among DEEs policymakers. Therefore, the precautionary demand for reserves is widely accepted by mainstream authors. The only point of contention lies in the adequate amount of these resources, marking the point where the precautionary demand for reserves ends and the mercantilist demand for reserves starts.

2.4.1.3 Mercantilist demand for reserves

It was the work of Dooley et al. (2004) that triggered the research on modern mercantilist policies by some economies. For these authors, several countries – especially in East Asia – were accumulating reserves due to their export-led strategy. Therefore, they had a potential "unlimited" demand for U.S. assets, as they were using these interventions to maintain their external competitiveness. This paper gave rise to a growing literature about the "mercantilist"[28] demand for reserves among DEEs. While the evidence of the existence of the mercantilist demand for reserves is mixed[29], there are three reasons why mainstream authors, in general, reject its desirability.

First, the standard mainstream analysis considers that even if monetary aspects can have an impact on economic activity in the short term, only real factors matter in the long run. Therefore, attempts to target competitive real exchange rates would only result

[27] Another interesting evidence found by Bussiere et al. (2013) is the complementary aspect between the accumulation of international reserves and the use of capital controls. In summary, their evidence suggests that the precautionary benefits of accumulating international reserves is amplified by the presence of capital controls.

[28] The choice of the term "mercantilism" already contains a pejorative meaning and denotes the rejection of this motive by mainstream authors.

[29] Aizenman and Lee (2007) and Obstfeld et al. (2010) find weak evidence of mercantilist motives while Ghosh et al. (2012) and Bussiere et al. (2013) find evidence of mercantilist behavior. Aizenman et al. (2015), on the other hand, find evidence of mercantilist behavior but they are not economically significant. These works differ in the way they measure the mercantilist behavior.

in inflationary pressures. This interpretation is rooted in the quantity theory of money and dates back to the Humean price-specie flow mechanism (see DeRosa (2009)). As Stone et al. (2009, p. 11) argue, '[i]n general, competitiveness is driven by the real exchange rate which, over the medium and long term, is beyond the control of monetary and exchange rate policy. [...] In most circumstances, a depreciated nominal exchange rate will feed into higher inflation and a higher real exchange rate, ultimately undermining competitiveness". This quantitative view underlies DeRosa's (2009) recommendation that central banks in DEEs should take a minimalist approach, focusing only on price stability through an inflation-targeting regime. Mishkin (2000, p. 105-106) argues along similar lines. For him, central banks in DEEs should adopt an IT framework centered on price stability not only because it enables the monetary authority to focus on the domestic economy, but also because it focuses the debate on "what a central bank can do in the long-run (i.e., control inflation) rather than what it cannot do (raise output growth, lower unemployment, and increase external competitiveness) through monetary policy."

This perspective is embedded in mainstream DSGE macroeconomic models of IT regimes in DEEs like Garcia et al. (2011) and Stone et al. (2009). In these models, the steady-state of the economy is exogenously determined, but rigidities allow monetary policy to have real effects in the short run. It is important to remark here that by abstracting from the long-term impacts of the exchange rate on competitiveness and the balance of payments, these models only tackle the relationship between the exchange rate and prices. In particular, trade deficits would cause unhelpful depreciation – due to the pass-through to prices, and therefore it would be advisable to use the base policy rate to resist depreciation in support of anti-inflationary policies. However, such a policy response could aggravate the trade deficit – especially with open financial accounts –, which is ignored in the analysis. In any case, the role of the exchange rate on inflation targeting regimes is not consensual. Fischer (2008), for example, agrees that exchange rate policies could be useful if they are subordinated to the inflation objective, while Mishkin and Savastano (2001) recommend a "benign neglect" of the exchange rate in the anti-inflation policy mix.

Secondly, there is a perception that the mercantilist hoarding of reserves was one of the roots of the "global imbalances" in the 2000s (Bernanke, 2005; Dorrucci, Ettore et al., 2006; Summers, 2006). This argument was popularized when Bernanke (2005) argued that the main reason for the significant current account deficits in the U.S. in the first half of the years 2000 was the existence of a global supply of savings (labeled a "global saving glut") flowing to the U.S. from DEEs. For him, the key reason behind the excessive current account surpluses in DEEs was the precautionary demand for reserves to buildup war chests against a financial crisis. However, he also noted that some countries were accumulating reserves in order to sustain their export-led strategies. The main effect in the U.S. of these global imbalances was the decrease in long-term interest rates that, at

the time of his writing, was fostering an increase in housing prices. Therefore, Bernanke (2005) suggested that DEEs should increase their financial liberalization to augment the capital flows to these countries, boosting their domestic consumption and alleviating the global savings glut problem. Although Summers (2006, p. 2) had a similar view, he emphasized the mercantilist demand for reserves when he argued that "global reserves of emerging markets are far in excess of any previously enunciated criterion of reserve need for financial protection" and suggested that the IMF should increase its control over competitive currency manipulation by its members. The Fund followed this suggestion, and since 2012 the IMF publishes its "External sector reports" with estimates of the size and possible sources of external imbalances, defined as "current accounts that are assessed to be out of line with fundamentals and desirable policies," and examines the broad external positions of the members, including their foreign exchange policies and interventions IMF (2012b, p. 5). In IMF (2012b), the conclusion is that several DEEs (in particular in East Asia) already had more than enough reserves for precautionary reasons – measured with the IMF (2011) metric – and thus intervention to accumulate reserves should be replaced by greater exchange rate flexibility. Bernanke (2009, p. 1) argued that "it is impossible to understand this [2008] crisis without reference to the global imbalances in trade and capital flows that began in the latter half of the 1990s". Obstfeld and Rogoff (2009) and IMF (2012b), although with a more nuanced view that underlines the role of lax monetary policy and of gross capital flows on the buildup of the financial crisis, also argued that the global imbalances created by excessive reserve accumulation was crucial to create the macroeconomic conditions that led to the financial crisis in 2008.

Finally, the last criticism of the mercantilist accumulation of reserves is that it creates an endless competition among DEEs to accumulate reserves. On the one hand, the DEEs are forced to imitate their peers and accumulate reserves to demonstrate economic robustness to the markets. This is the "keeping up with the Joneses" hypothesis raised by Cheung and Sengupta (2011). On the other hand, "mercantilist" DEEs compete for the same developed markets, and the use of exchange rate policies to boost their external surpluses create an accumulation race between these countries. For Aizenman (2008), this competition has the format of an asymmetric game in which the largest country (China) has an advantage. To save their competitiveness, smaller countries would be forced to accumulate reserves despite their carrying costs, in a typical beggar-thy-neighbor policy.

2.4.2 Advocates of Modern Monetary Theory

A common theme among modern money theory (MMT) writings is the unequivocal defense of floating exchange rate regimes based on the premise that they would guarantee the maximum policy space to undertake economic policies aimed at domestic objectives due to the absence of any commitments to defend a fixed exchange rate peg (Sardoni and

Wray, 2007; Tcherneva, 2016; Wray, 2014, 2015). Therefore, even when not spending or borrowing in foreign currency, governments that peg their currencies have to consider the effects of the chosen base interest rate and fiscal expenditures on the exchange rate. In this sense, they are not completely independent to pursue full employment and can be forced to break their promise to defend a parity. As Sardoni and Wray (2007, p. 1) argue, the ability to "implement monetary and fiscal policies independently ... is necessarily contingent on a country's adoption of floating exchange rates."

In this sense, MMT's take on exchange rate policies resembles the mainstream perspective of the monetary trilemma. For Sardoni and Wray (2007), fixed exchange rate regimes are only useful in the context of almost perfect capital immobility, which would be very difficult to achieve in a financialized world. In this context, floating exchange rate regimes are preferable even if they generate external instability in terms of currency volatility since they allow the government to focus on its domestic issues and avoid the disruption of peg abandonments. Hence, they argue that there is a trade-off between external and internal instability, with the former being less damaging. Therefore, the choice for macroeconomic autonomy must rely on the flexibility of the exchange rate. It "is just logic: pegging your currency adds a constraint" (Wray, 2015, p. 286).[30]

Furthermore, MMT authors underline that a monetarily sovereign country that allows its exchange rate to float is free to set the domestic base interest at its discretion while "dollarized" (and, implicitly, any fixed exchange rate regimes) countries are objectively constrained to set their base interest rate by three factors: i) the U.S. base interest rate, that constitutes an objective floor; ii) a risk-premium measured by the market's assessment of the country's creditworthiness; and iii) the need to keep the exchange rate fixed to another currency (Sardoni and Wray, 2007).[31]

Tcherneva (2016) further develops the opposition between fixed and floating exchange rate regimes and proposes a classification of monetary regimes according to the different degrees of monetary sovereignty.[32] At one end of the spectrum, there would be the full sovereign monetary regimes, where the government can issue national money, coordinates to guarantee that all government liabilities are denominated in the national currency, and clear all government payments. This is the "nonconvertible freely floating sovereign

[30]It is important to remark that both Sardoni and Wray (2007) and Wray (2015) note that countries can have fixed exchange rates and autonomous policies. The necessary condition is that they run large enough current account surpluses in order to accumulate huge stocks of foreign exchange reserves. Thus, the fixed exchange rate constraint depends on the ability to accumulate international reserves.

[31]As we are going to see in the next section, authors from the "currency hierarchy" tradition will argue that DEEs with floating exchange rate regimes will face exactly the same constraints in the absence of capital controls. In theory, exchange rate movements could absorb all the external movements; however, the effects of currency depreciation would jeopardize other policy objectives – particularly price stability – and shrink political support for the government policies.

[32]They are six in total. From the highest degree of sovereignty to the lowest, they are, respectively, "nonconvertible freely floating sovereign currency regimes", "pegged floats", "fixed exchange rate regimes", "currency boards", "dollarized regimes" and "monetary unions". The differences at the end of the spectrum are related to the flexibility to break the pegs.

currency regime" group, which is composed of the United States, Japan, and "most countries in the world" (Ibidem, p. 19). The distinctive characteristic of these regimes is the absence of a financial constraint on the government. Only real domestic resources can be a constraint for this group (which does not rule out the possibility of self-imposed legal constraints). At the other end of the spectrum are the countries that completely abdicated their monetary sovereignty by giving up the right of issuing their currency. These countries became "currency users" instead of "currency issuers." In this group, we can find dollarized nations like Ecuador and the European countries that adopted the Euro.[33] Countries in this group face an objective financial constraint: they must have foreign currency to spend. This money may be raised by taxes or by borrowing. However, Tcherneva (2016) notes that borrowing in a foreign currency puts these economies at the mercy of private financial markets. The persistence of this process might lead to a Ponzi financial cycle in which the indebted nations face ever higher borrowing costs, reinforcing their indebtedness and further undermining their ability to service these debts. In between these two extremes, there are the "pegged floats" regimes like crawling-pegs and the fixed exchange rate regimes (in its traditional form and then under currency board schemes that are more constrained than fixed regimes but less so than dollarized regimes).

Thus, MMTers defend floating exchange rate regimes because sovereign countries that float can afford to buy anything for sale in their currency, and they can freely determine the level of their policy interest rate. Moreover, they can always bid for foreign currency in the exchange rate markets to pay for their imports – although the exchange rate can vary significantly. Hence, they are free to adopt any combination of monetary and fiscal policies to achieve their own domestic goals while the exchange rate flexibility guarantees the stability of the external accounts.[34] Countries in fixed exchange rate regimes, on the other hand, are limited in their macroeconomic policymaking and, in extreme cases, lose completely their monetary sovereignty, becoming currency users.

As a consequence of their unequivocal preference for floating regimes, exchange-rate policies are of secondary importance for MMT authors. Given the importance of monetary sovereignty and the degrees of freedom allowed by floating exchange rate regimes in their framework, it is natural that MMT authors argue that the most efficient way

[33] We think that this argument should be taken with a big grain of salt. Although one can say that Ecuador and the national European central banks gave up their monetary sovereignty, the Euro is a European currency, and the European Central Bank answers to European needs, while the USD is managed by the American government and serves primarily American interests. Furthermore, the Euro is a currency that is almost at the top of the global currency hierarchy. See Prates (2020) for a thorough exposition of the differences between monetary sovereignty and position in the global currency hierarchy.

[34] According to Wray (2015, p. 128), this principle is valid for both developing and developed countries, and there is no meaningful difference between the issuer of the reserve currency (the U.S.) and the rest of the countries. He admits that the global demand for the USD might allow bigger current account deficits in the U.S., but claims that the question for DEEs is just at which exchange rate they will be able to acquire their imports. For him, "the sovereign government always gets 'free lunches' by keystrokes. [The difference is that] The US government potentially gets bigger lunches".

to reduce external vulnerability is to avoid external debt altogether (Sardoni and Wray, 2007; Tymoigne and Wray, 2013; Wray, 2015). As Tymoigne and Wray (2013, p. 40-41 and 49-50) argue, "[t]he position should be clear: MMT argues that sovereign currency increases policy space, so issuing debts in foreign currencies should be avoided." In another passage, they argue that "[i]n terms of development policy, the Treasury and the central bank of a country should avoid issuing financial claims that promise the delivery of a foreign currency. That would include the prohibition of 'bailing-out' domestic financial institutions that have issued liabilities in foreign currency. Let private sector firms go through the bankruptcy process if needed". Wray (2015, p. 127) also emphasizes this point, noting that countries indebted in foreign currency must service this debt and that it could run into debt servicing problems. "Thus, it is almost always a mistake for government to issue foreign currency bonds."

In this context, the accumulation of international reserves for precautionary reasons is briefly acknowledged as a possibility,[35] but at the end of the day, it is an unnecessary policy, for governments better avoid external debt altogether. Moreover, the accumulation of reserves is a costly substitute for capital controls, which should be adopted to avoid the instabilities generated by international financial flows. For Bibow (2008), foreign reserves are a "sunk cost." In a cost-benefit analysis, he argues that this policy is misguided since there would be no clear benefit from joining financial globalization, and thus there is nothing to be covered by this insurance. He proposes instead the adoption of capital controls that should aim at regulating both aggregate financial flows and their composition.[36]

MMT authors also recognize that the accumulation of international reserves, when associated with persistent current account surpluses, can buy policy space for countries that peg their exchange rates, as is the case of China. However, they note that net exports are a "cost" in real terms for the nation since goods produced locally are consumed abroad (Mitchell et al., 2019; Sardoni and Wray, 2007; Tcherneva, 2016; Wray, 2015). Instead, Sardoni and Wray (2007) argue that sovereign countries should allow their currencies to float and rip the benefits of net trade deficits while preserving their policy space to achieve full employment domestically. Even if they note that net exports could fill the demand gap in economies operating below full employment and that net exports can have multiplier effects that stimulate economic growth, they argue that it makes more sense, from a functional finance perspective, to adopt domestic fiscal policies at full employ-

[35]For instance, Wray (2015, p. 130) notes that one of the lessons that Asian nations learned from the 1990s crisis is that "massive reserves are necessary to fend off speculators" and Sardoni and Wray (2007, p. 3) argue that "the size of capital markets and the volume of daily transactions makes it very hard for single countries to effectively counteract and neutralize decisions made in these markets to defend their rate of exchange – unless they are able to accumulate huge 'war chests' of international reserves."

[36]Therefore, Bibow (2008, 2010a,b) considers that self-insurance policies and capital controls are substitutes. This position is controversial and several authors argue that they are in fact complementary policies (e.g., Bussiere et al. (2013) and Prates and Cintra (2007)).

ment. The current and government balances would adjust to the functional needs of the government. Hence, persistently targeting current account surpluses would be a "beggar thyself" strategy (Wray, 2015, p. 219).

Furthermore, it would also be a "beggar-thy-neighbor" strategy since all countries cannot run this strategy simultaneously. If every country on the planet were to follow this strategy, there would be a deflationary bias in the world economy that could trigger trade wars (Bibow, 2010b; Kregel, 2015; Wray, 2015). Bibow (2008, 2010b) links this discussion with the global imbalances that arose in the world economy previous to the global financial crisis of 2007-08. For him, the precautionary demand for reserves – defined as self-insurance policy by the author – together with neo-mercantilist strategies adopted by DEEs in the 2000s exerted a deflationary pressure on the U.S. economy. It depressed its goods and labor market, forcing the Fed to implement an excessively expansionary monetary policy to stimulate the economy. This compression of the policy rate led to an increase in consumer spending fueled by the expansion of mortgage debt. Therefore, it was not a "saving glut" that depressed interest rates in the U.S. but an excessive international "liquidity preference" that put excessive upward pressure on the USD and induced the Fed to react by sharply reducing its interest rates. Therefore, he argues that the hoarding of reserves by DEEs is unsustainable from a global perspective.

The biggest contribution of MMT authors to the post-Keynesian debate on exchange rate policies and external vulnerabilities debate is their emphasis on monetary sovereignty. A country indeed has a bigger policy space to pursue its domestic goals if it issues and uses only its sovereign currency since it can never be forced to default on it. Furthermore, any country that uses only its sovereign currency should have the ability to determine its policy interest rate. Therefore, there would be no substance in the arguments that external debt is needed to fund the government due to the lack of domestic savings nor that external debt is always cheaper than domestic debt.

However, MMT proponents fail to understand the structural differences between distinct currencies in the international monetary and financial system (IMFS) that is asymmetrical and hierarchical (Bonizzi et al., 2019; Vernengo and Perez Caldentey, 2019). As a consequence, they generalize arguments that would be valid in principle only for the United States and, to a lesser extent, to a few other central governments. This failure is at the root of their trilemma-based insistence on the advantages of floating exchange rate regimes. In particular, nothing prevents floating regimes from experiencing a sustained real exchange rate appreciation, as happened to many countries that pegged their currencies in the 1990s. Furthermore, the international demand for USD makes the United States a special country because it can almost freely run current account deficits. For DEEs, a current account deficit can only exist if there is an equivalent financial surplus (assuming away the unsustainable depletion of international reserves). However, financial investments will not occur if local rates of return are smaller than what can be obtained

in central markets. In other words, it is not reasonable to believe that foreigners will make financial investments in DEEs running current account deficits and offering interest rates that are lower than in the global financial centers. Therefore, only the issuer of the global reserve currency can have at the same time an independent monetary policy and current account deficits, even with capital controls. In this context, the adoption of a MMT policy mix of low-interest rates and expansionary fiscal policy can lead to a fast depreciation of the currency (higher imports combined with financial outflows instead of inflows) that would be transmitted to domestic prices, causing inflation that would undermine the whole set of economic policies.

Finally, their insistence that exports are a "cost" and imports are a "benefit" is true only from a static, short-term perspective. A steady flow of imports is crucial for DEEs trying to catch-up with state-of-the-art technology, and the failed experiences of import substitution strategies in Latin America in the last half of the 20th century is an example of the constraint imposed by the availability of external resources for these countries. Moreover, international markets are the arena where these countries can test their technological developments. Therefore, far more paradoxical than it looks, the persistent achievement of current account surpluses (external dissaving) can stimulate domestic investment, and therefore exports could be a "benefit" from a dynamic perspective. Of course, it is not possible for every country to adopt this strategy at the same time. However, given the constraints of the IMFS, advanced countries that issue international currencies should be more flexible in accepting current account deficits than their DEEs peers. These arguments are developed further in the next subsection, where we explore the contributions of the structuralist post-Keynesian authors to the debate.

2.4.3 Structuralist post-Keynesians

The role of the balance of payments in the long-run economic trajectory of DEEs has been emphasized by many Latin American structuralists and post-Keynesian authors for a long time (e.g., Lavoie (2014); McCombie (2003); Tavares (1972)). However, the growing financialization and liberalization of financial flows in these economies triggered a surge in the literature that combines these elements with the volatility created by global investors (Bonizzi, 2013). In particular, the cyclical availability of foreign finance makes the monetary authorities hostage of the diktats of global financial markets and force them to act in a procyclical way (Farhi, 2006; Ocampo, 2012). As we saw in the previous section, policymakers in DEEs must make their decisions in the context of the global liquidity cycles that intercalate periods of an abundance of external investments in their economies with periods of scarcity. This situation creates a scenario of "balance of payments dominance." As Ocampo (2012) argues,

> "Under this regime, the balance of payments exercises strong *cyclical* shocks, through trade and the availability and costs of external financing. The latter include movements in risk spreads (reductions during booms, increases during crises) that reinforces the cyclical effects in the availability of finance and may generate procyclical variations of domestic interest rates. In turn, both the trade and the capital account tend to generate cyclical effects on exchange rates (appreciation during booms, depreciation during crises) that have more ambiguous effects. Under these interest and exchange rate pressures, macroeconomic authorities have to fight hard to build the space for effective countercyclical macroeconomic policies." (Ocampo, 2012, p. 4, emphasis in the original)

In the structuralist post-Keynesian view, exchange rates are the main transmission channel of these cycles to DEEs. Therefore, they should not be left to market forces alone (e.g., Fritz et al. (2018); Guttmann (2015); Prates and Cintra (2007)). This subsection aims to analyze the policy challenges faced by peripheral countries in this situation and the recommendations made by structuralist post-Keynesians authors to deal with them. Exchange rate policies aim at two targets: to decouple from the global liquidity cycles, minimizing the effects of unstable financial flows, and to preserve a stable and competitive real exchange rate that allows the country to reap the benefits of trade integration. Monetary authorities can intervene directly in the foreign exchange rate markets and impose regulations on financial flows[37] to achieve these objectives. We understand that both policies complement each other, as noted by Bussiere et al. (2013) and Fritz et al. (2018), and De Paula et al. (2017). Nonetheless, since our focus is on market interventions, we will not explore further the topic of capital controls in this thesis.

As mainstream authors correctly point out, currency mismatches[38] severely reduce the policy space of monetary authorities. These constraints become clear during crisis episodes where there is a sudden stop of financial flows, as was the case during the 1990s crisis. Countries with currency mismatches and current account deficits face a dilemma in these situations: the sudden reduction of foreigners willing to invest in the local economy exerts significant pressure in their foreign exchange markets, but the depreciation of their currencies will have significant patrimonial effects on the economy. Therefore, they are almost forced to pro-cyclically increase the policy interest rates and use their reserves in the middle of the crisis to at least try to stabilize their currency, amplifying the contractionary effects of the shock (Kaminsky et al., 2005). As a consequence of the 1990s crisis, several DEEs realized that the only way to deal with these situations without

[37] Nowadays, the regulation of financial (in)flows is widely accepted by the literature (Akerlof et al., 2014; Bibow, 2008; De Paula et al., 2017; Ghosh et al., 2018; IMF, 2012a; Rey, 2013).

[38] Eichengreen et al. (2007, p. 130) define currency mismatch as "differences in the values of the foreign currency-denominated assets and liabilities on the balance sheets of households, firms, the government, and the economy as a whole."

placing much strain on their policy interest rates was to hoard international reserves to bridge sudden stops of financial flows.

The importance of this precautionary demand for reserves can be found already in the work of Keynes (1930, chapter 33). For Keynes, the central bank should decide the appropriate level of free reserves (which is to be understood in equivalence with international reserves nowadays) in order to create a "war chest" that would provide liquid resources to "meet short-period fluctuations in the international balance of indebtedness, ... the external drain" (Ibid., p. 275). This war chest must consider the probable amount of the "sudden withdrawal of foreign funds" (Ibid, p. 277) and the temporary fluctuations against which it is unnecessary to make fundamental adjustments. Furthermore, he notes that a country which is "largely dependent on a small variety of crops highly variable in price and quantity – Brazil, for example – needs a larger free reserve than a country of varied trade" (Ibid., p. 277). Finally, he also notes that an appropriate level of free reserves is needed "for merely psychological reasons, to promote confidence" (Ibid., p. 275).

It is important to emphasize that the buildup of this war chest of foreign reserves is usually undertaken during the upper phases of the liquidity cycle when there is an abundance of foreign currency flowing to the country. On the other hand, the policy space of the authorities is objectively constrained by the stocks of international reserves in the central bank in the descendant phase of the cycle, when the exchange rate is depreciating, and capital is outflowing the country. In this situation, the main objective of the central bank should be to smooth the depreciation of the exchange rate and to assure that hedging markets are functioning to avoid disruption in the private sector. However, the attempt to preserve the exchange rate indefinitely at a level that is incompatible with economic fundamentals – reflected by current account deficits – will harm the productive sector of the economy and exhaust the central bank's international reserves. In this sense, if fundamental adjustments are needed, the government can smooth the process, but it must allow the exchange rate to depreciate. We discuss these issues in chapter 4, where we discuss the utilization of DNDFs by the Brazilian Central Bank.

On the other hand, structuralist post-Keynesian authors, especially those related to the new developmentalist school, emphasize the importance of stable and competitive real exchange rates (SCRER) to neutralize the Dutch disease and preserve the external competitiveness of the industrial sector of the economy. A corollary of this strategy is the export orientation of these sectors, which is also important to avoid the distortions of protected markets and to expose the industry of these countries to international competition (Fajnzylber, 1992). The frequent balance-of-payments crises of the import substitution industrialization model in the mid-20th century in Latin America due to the always higher demand for imported capital goods[39] (Tavares, 1972) contributed to this renewed focus on

[39] Kaldor (1966) presents a similar argument.

current account balances. Rocha and Oreiro (2013), for instance, explicitly model an investment function with an external constraint in order to capture the fact that investment is restricted by the capacity to import.

These authors stress the importance of industrialization – understood as the development of non-traditional tradable sectors that embed technological progress – because these activities are known by their learning-by-doing externalities and technological spillovers, stimulating technological progress and structural change in the economy. Furthermore, the economies of scale associated with industrial activities lead to higher employment and productivity gains in such sectors,[40] leading to higher real wages that would balance the negative effect that active exchange rate policies targeting a competitive currency can have on them (Gala, 2008; Missio et al., 2015; Oreiro et al., 2020). Therefore, new developmentalists stress that a stable and competitive exchange rate is crucial to industrial development, increasing the attractiveness of domestic goods abroad and in domestic markets. In other words, it would foster import substitutions and the promotion of exports. As Bresser-Pereira (2018, p. 2, emphasis in the original) argues, "the exchange rate acts as a *switch* that grants or withholds *access* to existing demand, be it international or domestic."

Furthermore, Bresser-Pereira (2010) argues that there is no contradiction between an export-oriented strategy and the development of domestic markets. For him, a competitive exchange rate allows DEEs to compete internationally and to diversify towards technologically intensive products. As a result, they are a source of demand from the external side and encourage the growth of investment in the economy. As Rodrik (1994) noted when analyzing the development of Korea and Taiwan, export-oriented policies were important to enable a steady rise in imported capital goods, while the main growth engine was the substantial rise of industrial investment. The works of Dullien (2015), Gala (2008), Missio et al. (2015), and Rocha and Oreiro (2013) present empirical evidence of the positive relationship between growth and competitive exchange rates.

These arguments are criticized by the Latin American Sraffians, another group of Latin American economists close to the post-Keynesian tradition. This critique is mainly found in Dvoskin and Feldman (2015) and Dvoskin et al. (2020). At a general level, these authors counter the connection between a devaluation of the exchange rate and economic growth and emphasize the contractionary effect of an exchange rate devaluation on real wages. On the one hand, such devaluation would immediately reduce the effective demand, possibly triggering a recession in the economy. On the other hand, such reduction of wages can increase the distributive conflict in the economy, which can lead to an inflationary spiral. From a policy perspective, they argue that even if it was possible to use the exchange rate as a tool to develop some industrial sectors, it would require a precise identification of industrial sectors to be developed and an understanding of the secondary effects that

[40] This argument can also be found in the work of Kaldor (1966).

this change would have on distributive variables in the economy. At a formal level, these authors emphasize that the relationship between the profitability of firms and the real exchange rate is nonlinear, and the effect of a devaluation of the exchange rate on profit rates is indeterminate when non-tradable goods are allowed to be used as an input in the tradable sectors. In this scenario, some industries may lose their competitive edge as a consequence of the devaluation.

In both papers, the authors refer to Frenkel and Ros (2006) as the stereotypical paper on the new developmentalist view. In this paper, Frenkel and Ros (2006) argue that there are three channels through which a depreciation of the exchange rate would lead to economic growth. The first channel operates in the short-run and is labeled as the "labor intensity channel." Through this channel, a devaluation of the exchange rate would decrease wages in foreign currency, and this supply shock would stimulate production in tradable sectors. This argument implicitly assumes that the demand for a country's exports is infinitely elastic, i.e., the rest of the world will absorb any extra production induced by the fall in real wages. Furthermore, it ignores the effect that lower real wages will have on the domestic aggregate demand (Dvoskin et al., 2020).

The second channel pointed by Frenkel and Ros (2006) that they analyze is the "macroeconomic channel," which operates in the medium-run. Through this channel, a depreciation of the exchange rate would, given a certain monetary level of wages, lead to a fall in the small open economy's export prices, thereby leading to higher exports. The first problem with this notion is that not all nations can follow this strategy simultaneously, for, in this case, there would be a run to the bottom in international markets, with wages falling everywhere without any nation becoming more competitive than their peers. Furthermore, the reduction of aggregate demand induced by lower real wages could more than offset the positive effect of higher exports on the total outcome, especially if the propensity to consume of exporters is smaller than the propensity to consume of workers. Finally, nothing prevents local companies from cashing the higher income from their exports without increasing production (Dvoskin et al., 2020; Dvoskin and Feldman, 2015).

Finally, the last transmission channel cited by Frenkel and Ros (2006) that they cover is the "development channel" that would work in the long run. This channel would connect a devaluated exchange rate with development through higher investments in more productive sectors and thereby to higher economic growth. They note that this channel presupposes that investment rates are a function of the profit rates and that profit rates would increase through the exchange rate effect. However, they argue that the connection between exchange rates and profit rates is not a given, especially when the distributive impact of an exchange rate depreciation is evaluated in an economy with workers, capitalists, and rentiers. For example, why wouldn't a depreciation of the exchange rate lead to higher rents in the commodity sector, attracting resources from other tradable sectors?

Even if one accepts the direct connection between exchange rates and profit rates as posed by new developmentalists, Dvoskin et al. (2020) argue that this long-run connection would only hold if no subsequent increases in wages were to happen. Yet, real wages might rise due to the workers' attempt to re-establish their initial wages or the increased bargaining power of workers that would arise due to the higher employment levels induced by the growth in the tradable sectors. In the limit, these problems could lead to inflationary spirals due to the distributive conflict in the economy.

The main problem with the Latin American Sraffian critique is that it ignores the context in which new developmentalist policies are recommended. As we discussed in section 2.3, the hierarchical structure of the international monetary and financial system is such that financially open DEEs tend to attract portfolio investments in the upper phase of the global liquidity cycle, which leads, if left unfettered, to current account deficits and therefore to a real appreciation of their exchange rate.[41] However, these investments can suddenly disappear in the downturn of the cycle, leading to an abrupt depreciation of the exchange rate, as we argued earlier and will detail further in chapter 3. Therefore, all the complications derived from switching techniques in the industry that might occur if the government pushes for a competitive exchange rate policy will take place sooner or later due to market forces in an economy that allows its currency to float freely. That is why structuralist post-Keynesians argue that if the crisis is unavoidable, policymakers should at least try to take advantage of the depreciation to implement a stable and competitive exchange rate policy, avoiding the repetition of the cycle.

From the perspective of policymakers in DEEs, it is crucial to understand that they have only partial and asymmetric control of their exchange rates. It is partial because, in the absence of capital controls, exogenous factors – particularly the effects of the global liquidity cycle – will impact their exchange rates. On the other hand, it is asymmetric because while DEEs have no intrinsic constraints to intervene when accumulating reserves and fending off a real appreciation of their exchange rates, they are much more limited to intervene on the other side of the market. Even if clever solutions are found, like the DNDFs issued by the Brazilian Central Bank that can increase the offer of foreign currency in the forex markets without using the international reserves of the central bank, the policy remains at the limit constrained by the acceptability of these instruments by market participants, as we discuss in chapter 4. This asymmetric aspect is further reinforced by the fact that exchange rates in DEEs react strongly to a reversal of the liquidity cycle than to their upward phases, as we show in chapter 3.

On the other hand, the argument that a policy that targets a competitive exchange rate can trigger an inflationary spiral is well-founded due to the pass-through from the exchange rate to prices (Braga, 2013; Serrano, 2010) and the distributive conflict it gener-

[41] We assume here implicitly that a neutral real exchange rate is the exchange rate consistent with a balanced current account result at full employment.

ates. Structuralist post-Keynesians close to the new developmentalist tradition not only agree with this point but emphasize that policymakers are inclined to allow the overvaluation of the exchange rate due to its side-effect role in controlling prices at the same time as it leads to inflated real wages and financial incomes. These results are usually achieved at the expense of domestic competitiveness, leading to higher penetration of imports in the productive structure of firms at the micro-level and to larger current account deficits at the macro-level (Marconi et al., 2020; Oreiro et al., 2020). The development of a coalition between workers and rentiers in support of these policies is usually pointed out as one of the main barriers to the implementation of SCRER policies (Oreiro et al., 2020). Therefore, structuralist post-Keynesians argue that policymakers should refrain from using the exchange rate to control consumer prices (Barbosa Filho, 2015; Bresser-Pereira, 2010).

Finally, we think that the point to retain from the new developmentalist argument is that industrial and technological development requires time to mature. If the argument raised by Sraffian economists is valid, then exchange rate swings are harmful to industrial development as they would constantly change the profitability of the different economic sectors. This lack of long-run stability is detrimental to technological development. Therefore, even if the critique between the direct connection between the depreciation of the exchange rate and industrial development as raised by the Latin American Sraffians is convincing, the sectors that strive in an overvalued exchange rate context do so by increasing their dependency on imported intermediate goods and external financing. These industries become exposed to a depreciation of the currency that can wipe them out from the markets (Forni and Turner, 2021; Marconi et al., 2020). Nalin and Yajima (2020) show with a stock-flow consistent model calibrated for the Mexican economy that industries dependent on imported goods and external finance for their investments do not fully recover from a negative shock on the exchange rate in the steady-state, indicating the presence of a hysteresis effect. In this paper, the authors recover important stylized facts about the negative effects of currency depreciation. On the other hand, active foreign exchange rate policies in the ascendant phases of the cycle can prevent these effects. Frankel and Saravelos (2012), for example, show that low levels of international reserves and real appreciation of exchange rates previous to the 2008 crisis were the two most significant predictors of the severity of the depreciation during this crisis.

Therefore, when Frenkel and Rapetti (2015) suggest a stable and competitive real exchange rate as a macroeconomic target, the word “stable” must be emphasized. One of the main arguments that we raise in this thesis is that any exchange rate policy in DEEs that aims to stabilize the real exchange rate is doomed to fail if the country is running persistent current account deficits, and persistent current account deficits will arise during the upper phases of the global liquidity cycle in DEEs since the hierarchical monetary system leads to a structurally positive interest differential (Fritz et al., 2018). Moreover, this process is aggravated if these countries suffer from the Dutch disease.

Therefore, competitive exchange rate policies are important not because they directly stimulate economic growth and technological development but because they create long-run stability in developing economies, allowing industrial policies – that bet on long-run capability building – to be effective (De Paula et al., 2017; Marconi et al., 2020; Oreiro, 2020; Pereira and Dathein, 2016).

In summary, the structuralist post-Keynesian take is that direct market interventions of the central bank can help[42] decrease the country's external vulnerability (precautionary demand for reserves) and preserve the competitiveness of its industrial sector. As Frenkel and Rapetti (2015) argue, a SCRER is growth-enhancing because it relaxes the external constraint on domestic activity, minimizing the risks of sudden stops and financial crises, and stimulate modern tradable sectors that are crucial for economic development. As a consequence, the accumulation of international reserves to avoid excessive overvaluation should be considered part of the precautionary policies. Moreover, the accumulation of international reserves together with real exchange rate policies can help DEEs authorities to safely reduce the interest rate differential to global reference rates, given that they do not need foreign resources to sustain a trade deficit.

It is important to remark that there is no technical constraint on the government to accumulate reserves, as the central bank uses its own money to purchase foreign currency, and it can always compensate this policy on the domestic interbank market to keep the base interest rate stable. We discuss this issue, which is closely related to the compensation thesis, in chapter 5.[43] Therefore, structuralist post-Keynesians reject the bipolar view of hard-pegs or pure floating regimes and argue that the higher policy space is found exactly in intermediate regimes. In these regimes, DEEs' policymakers retain the right to intervene when they consider it convenient – reducing the uncertainty derived from unstable capital flows and volatile exchange rates –, but do not commit to defending any specific parity. The pros and cons of different exchange rate regimes depend on the circumstances. Bresser-Pereira (2010) summarizes the point neatly:

> "the pragmatic solution is to reject the 'fix or float' alternatives and to manage the exchange rate to prevent its appreciation, whether by keeping the domestic interest rate at a low level, by acquiring international reserves, by levying taxes on the goods that cause the Dutch disease, or during temporary periods by imposing controls on capital inflows." (Bresser-Pereira, 2010, p. 160)

[42] In addition to the regulation of capital flows, Bresser-Pereira (2010) and Guzman et al. (2018) also defend the imposition of a tax on the export of raw materials, which would effectively create a system of multiple exchange rates.

[43] Obviously, an unreasonably frequent interventions would imply an ever-higher exchange rate, which makes no sense as a policy strategy.

Chapter 3

Up the stairs, down the elevator? The asymmetric relationship between the global liquidity cycle and emerging markets' currencies[1]

Abstract: This paper assesses whether there is evidence of an asymmetric relationship between the global liquidity cycle and the currencies of developing and emerging economies (DEEs), a central tenet of the Minskyan interpretation of the exchange rate behavior in these economies and the "financialization in developing and emerging economies" literature. We use a novel panel model technique that incorporates asymmetric components to fixed-effects regressions to check if there is evidence of such asymmetry. Our results suggest that capital flows, commodity prices, and the VIX have a more substantial relationship with the currencies of DEEs during the retrenchment of the global liquidity cycle than during its expansionist phase. In other words, our results suggest that the currencies of DEEs take the stairs up and the elevator down.

Keywords: Exchange rate; financialization; liquidity cycle; developing economies.
JEL codes: F31; F32; G15

3.1 Introduction

In 2012, Dilma Rousseff, the former Brazilian president, accused the developed countries of causing an undue appreciation of currencies worldwide. According to her, their cheap

[1]This chapter was co-written with Professor Pedro Rossi. The ideas developed in the paper were conceptualized together after several meetings. I was the main responsible for writing, gathering the data, and implementing the econometric methods. The code to replicate this chapter is available at https://github.com/joaomacalos/up-the-stairs-down-the-elevator

money policies were producing a monetary tsunami that flooded the international markets. One year later, the sole menace of the tapering of the quantitative easing policies in the United States was enough to trigger a sudden withdrawal of capital from the developing world, with substantial destabilizing effects (Eichengreen and Gupta, 2015). These events highlighted the growing impact of the decisions of international investors and the monetary policy stance in the advanced economies on the determination of exchange rates in the developing and emerging economies (DEE). Since the liberalization of DEEs' financial accounts in the 1990s, these decisions became ever-more important.

The "financialization in DEEs" literature grew substantially in the last twenty years to understand the consequence of these events (Bonizzi, 2013; De Conti et al., 2014; Kaltenbrunner, 2015b; Ramos and Prates, 2018). This literature emphasizes the existence of a hierarchy of currencies in the international monetary and financial system (IMFS), with some being safer than the rest (Carneiro, 2008; Prates, 2002). Among the many implications of this hierarchy, one that is particularly important is the perception that DEEs attract substantial financial investments when global investors are accepting higher risk in exchange for yields but witness the quick reversal of these flows when global uncertainty increases.

The last decades also highlighted that the booms and busts cycles in the periphery are becoming ever-more synchronized. This phenomenon points to the importance of the global liquidity cycles (GLC) in the determination of the exchange rates and financial flows to DEEs (Biancareli, 2009; De Conti et al., 2013a; Shin, 2016). One aspect of these cycles is its asymmetry. While its ascendant phases are longer and marked by the gradual appreciation of exchange rates, the bust is generally abrupt, with sudden outflows of capitals and a sharp depreciation of the exchange rates. Although many authors highlighted the existence of these cycles, few empirical studies investigated this asymmetric behavior in detail. The main objective of this paper is to fulfill this gap. We use econometric panel data estimations to analyze whether there is evidence of an asymmetric relationship between the global liquidity cycle and the pressures in the exchange rate markets of a panel of DEEs. Our findings support this hypothesis. In particular, our estimates provide evidence that the coefficients of all global liquidity cycle' variables associated with its descendant phases are bigger than the coefficients associated with its ascendant phases.

This paper is structured in six sections, together with this introduction. In section 3.2, we review the currency hierarchy literature and relate it with the GLC, presenting descriptive statistics that contextualize the paper. In section 3.3, we discuss the asymmetry between the ascendant and descendant phases of the GLC and how they relate to the currencies of DEEs. In section 3.4, we present the data and the methodology adopted in this work. The results are presented in section 3.5. Finally, section 3.6 concludes the paper with our final remarks.

3.2 The structural specificities of DEEs and the global liquidity cycle

There is a growing literature concerned with the specific structural features of developing and emerging economies, especially regarding the role of exchange rates in these countries. Mostly influenced by the Latin American structuralist and post-Keynesian schools of thought, these authors have been arguing that the exchange rates and the balance of payments are crucial to understanding the macroeconomic dynamic of peripheral countries, especially those that have engaged in the process of financial globalization. Among these authors are those associated with the "currency hierarchy" approach, who emphasize the structural asymmetries of the IMFS and its consequences on the exchange rate dynamics and the autonomy of the macroeconomic policymakers in these countries (Carneiro, 2008; De Conti et al., 2013b; Kaltenbrunner, 2015b; Ramos, 2016).

The currency hierarchy approach underlines the consequences of the financial integration of DEEs to the global markets. Since only a handful of currencies are used and accepted internationally, De Conti et al. (2013a) argue that different currencies enjoy different degrees of liquidity[2] internationally. The IMFS, therefore, has a pyramidal structure with the dollar (USD), the most used currency worldwide, in its apex. A crucial consequence of this hierarchical system is that the base USD interest rate sets the benchmark for all other interest rates. Hence, the further away from the apex a country is, the highest must be the compensation in the form of interest rates that its monetary authorities must offer to attract financial investments to their countries.

Moreover, one of the characteristics of the global financial markets nowadays is the existence of a global common component that drives financial flows, especially credit and portfolio flows, and the price of risky assets like corporate bonds worldwide. This common component behaves cyclically and affects the economies in different stages of their business cycles. Therefore, contemporary markets are marked by "powerful financial cycles characterized by large common movements in asset prices, gross flows, and leverage" (Rey, 2015, p. 2), that give rise to many interactions between "the monetary conditions of the centre country (the US), capital flows and the leverage of the financial sector in many parts of the international financial system" (Ibid., p. 2). Therefore, the existence of global liquidity cycles with the monetary policy decisions of the United States and other advanced economies in its epicenter is a structural feature of the contemporary IMFS (De Conti et al., 2013a; Guttmann, 2016).

[2]For De Conti et al. (2014, p. 347), liquidity is defined as the capacity of an asset to be quickly transformed in means of payment without capital losses. Therefore, an asset has international liquidity if it can be transformed quickly and without losses into an internationally accepted means of payment, i.e., into a currency at the top of the hierarchy.

Periods of surges in financial flows to DEEs and easy credit conditions worldwide that are followed by periods of global risk-aversion and retrenchment from peripheral markets portray the global liquidity cycles (Biancareli, 2009; Forbes and Warnock, 2012; Ghosh et al., 2014). For De Conti et al. (2013a), the lower global liquidity preference that marks the upper phase of the GLC increases the attractiveness of the structurally positive interest rate differential offered by the countries lower in the monetary hierarchy and foster carry trade operations[3]. These operations trigger financial flows that appreciate the currencies of DEEs, which further reinforces the profitability of these speculative operations.

However, instead of being driven by a genuine preference of global investors for DEEs, most of these financial flows are determined by the profitability constraints imposed by the low rates of return in the central economies (Bonizzi, 2017). Hence, even when international investors allocate their investments in locally denominated assets, they prefer flexible positions like stocks and government securities that can be quickly dismantled. These contingent liabilities in foreign currencies can create sudden pressures on the exchange rate markets of these economies (Kaltenbrunner, 2015a). To aggravate the situation, the depreciation of DEEs' currencies triggered by the reversal of the GLC decreases the value of their eligible collateral in USD, which further constrains their access to global credit and capital markets and reinforces the reversal of the cycle (Shin, 2016). Therefore, in a pendulum movement, the joint movements of financial flows to DEEs, surges and retrenchments in carry trade operations, and the variation of commodity prices, lead to the appreciation of the DEEs' currencies in the upper phases of the GLC and their depreciation in the descendant phases of the cycle.

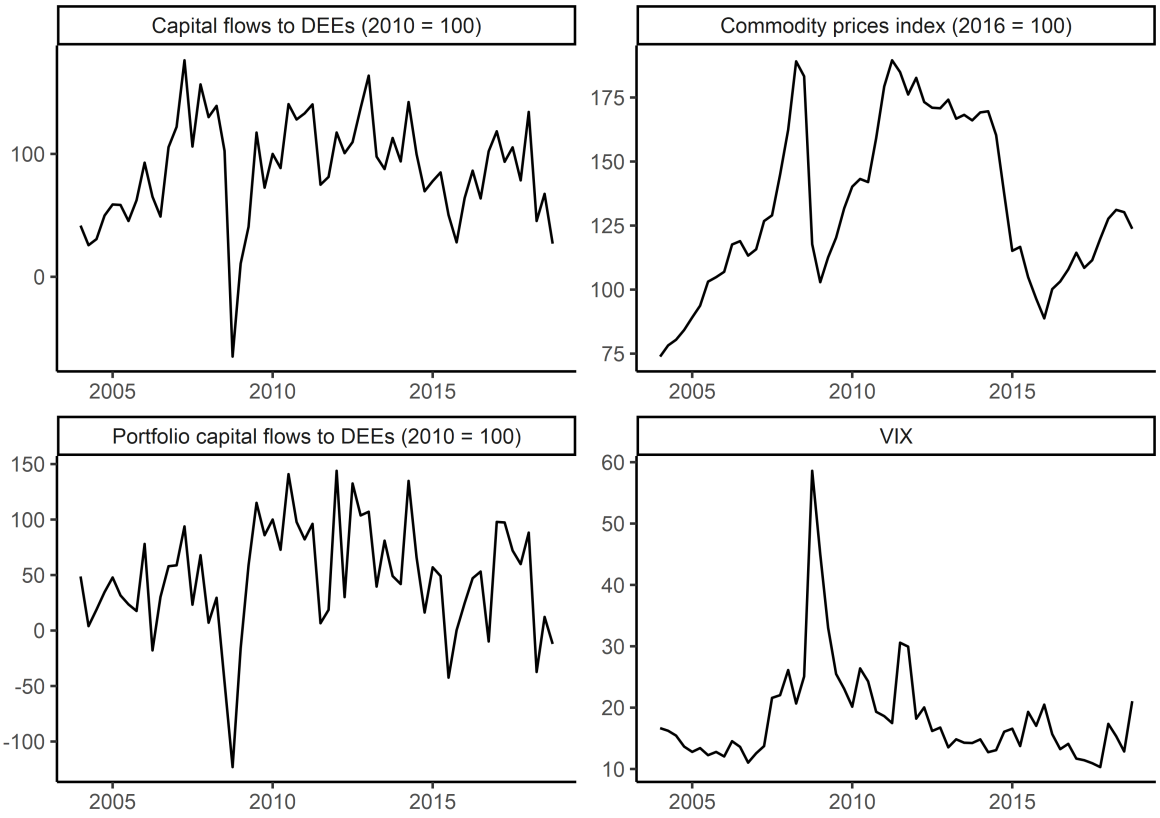
3.2.1 Stylized facts

Figure 3.1 presents the four different indicators that are used in our empirical analysis and provides a good overview of the global liquidity cycle in the last two decades. The total liability financial flows to the DEEs countries between 2003 and 2018 are presented in the upper-left part of Figure 3.1. In its upper-right part is displayed the "all commodities" prices index estimated by the IMF. In the bottom-left of Figure 3.1 is the total net portfolio debt inflows to the selected group of DEEs. Finally, the VIX[4] – a standard indicator of global liquidity preference – is in the bottom-right part of Figure 3.1. It is interesting to note that the capital flows and the commodity index plummeted in 2008 and 2015, whereas the VIX – that increases together with the global risk aversion – only spiked in 2008.

[3] A carry trade is an inter-currency investment where a liability (or a short position in derivative markets) is formed in the low-interest rate currency and an asset (or a long position) in the highest interest rate currency (Rossi, 2016).

[4] "Chicago Board Options Exchange Volatility Index."

Figure 3.1: Global liquidity cycle indicators, 2004Q1 to 2018Q4.



Source: IMF and FRED.
Authors' elaboration.

The synchronized relationship between the GLC indicators and the exchange rates from a group of DEEs, an essential feature of the GLC, can be visualized in Figure 3.2.[5] Figure 3.2 is divided into two parts. In its left side is presented a correlation map between the log-variation of the bilateral exchange rate with the USD of the DEEs currencies included in our empirical analysis with each other and with the bilateral exchange rates with the USD of the Euro area, the United Kingdom, Japan, China, and Switzerland. The log-variation of the commodity prices index, the log-variation of the total financial flows, and the log-variation of the VIX indicator are included in the correlation map as well. The right side of Figure 3.2 summarizes the correlation map by showing the average correlation between individual bilateral exchange rates or GLC indicators with the currencies of the group of DEEs included in our empirical analysis.

Since we measure the exchange rates as the price in dollars of one unit of the local currency, the appreciation of these currencies is captured by a higher value of the respective exchange rate. As a consequence, we chose to measure the series of capital flows to DEEs and of the commodity price index as their inverses in the correlation map to

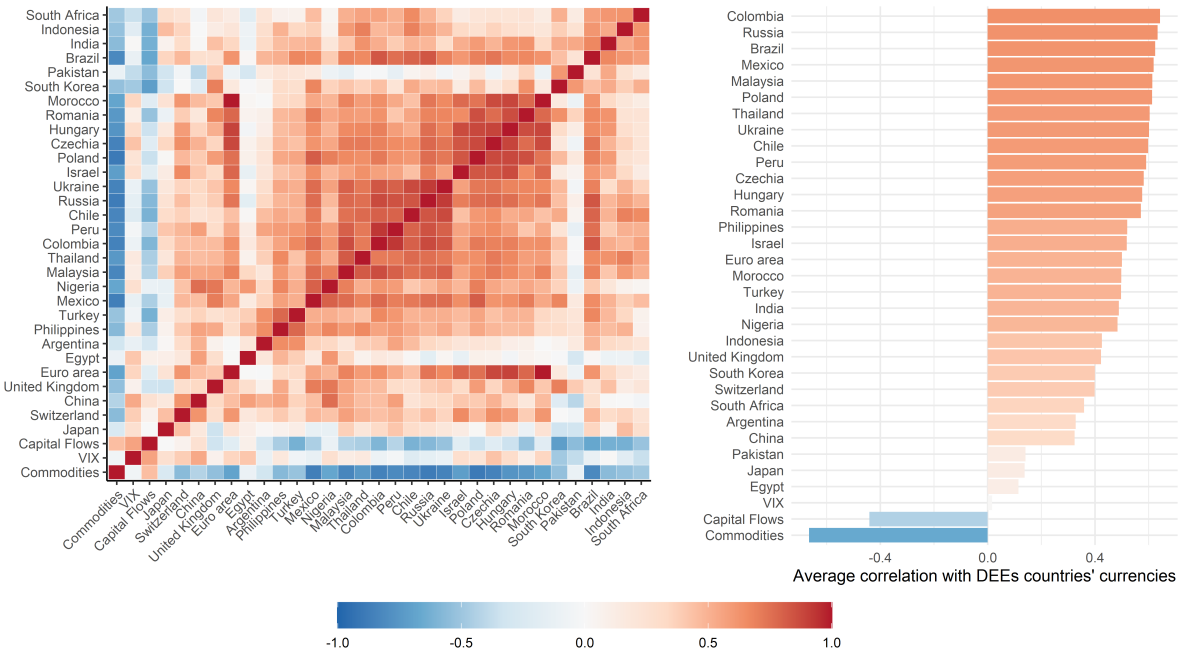
[5]The correlation matrix is calculated using variables in annual frequency. We detail the selection criteria of DEEs in section 2.4.

emphasize the relationship between the exchange rates and the GLC indicators. In this way, a positive correlation between the appreciation of the exchange rates and positive variations of capital flows will be captured by a negative correlation coefficient. Figure 3.2 highlights two critical aspects of this relationship.

The first is the synchronized variation of the exchange rates among the group of selected DEEs (the red bulk in the middle-right portion of Figure 3.2, left panel). With some exceptions (notably Egypt and Pakistan), the currencies of the 25 selected DEEs appreciated and depreciated together in the last 15 years, with the average correlation among the DEEs currencies being 0.506 and the median being 0.571. The second aspect is that these currency movements were highly correlated with the variation of commodity prices and with the variation of liability financial flows to the group of DEEs.

On the other hand, it is interesting to note that the correlation between the log-variation of the VIX with the exchange rates is mixed, with mild positive and mild negative correlations. The difference between the correlations of the group of DEEs currencies with each other with the advanced economies is also noticeable, with the latter being significantly lower[6] than the former. It is also remarkable the difference between China and the DEEs group, particularly the relationship between its currency and the capital flows indicator.

Figure 3.2: Correlation matrix and average correlation between DEEs exchange rates and key global liquidity cycle indicators



Author's elaboration based on IMF and FRED data.

[6]The exception is the high correlation between the Euro area and the DEEs group. However, this is not surprising given the relationship between the euro and the Eastern European block and the fact that the Moroccan Dirham is pegged to the Euro.

3.3 The asymmetric relationship between the currencies of DEEs and the Global Liquidity Cycle

Cross-border flows play a vital role in the global liquidity cycles since inflows lead to credit expansions and thereby to higher economic activity without expressive price pressures as they appreciate DEEs currencies. The apparent success in the upper phase of the GLC hides the buildup of real and financial fragilities in the background, and the reversal of cross-border flows wreaks havoc in these economies (Aliber and Kindleberger, 2015; Blanchard et al., 2017; De Gregorio, 2010; Godin and Yilmaz, 2020). Importantly, the expansionist phase of these cycles is gradual and persistent, while its reversal is often abrupt. This asymmetric cycle resembles the financial instability hypothesis outlined by Minsky (1992) and led many authors to use a Minskyan framework to analyze these cycles (Arestis and Glickman, 2002; Bresser-Pereira et al., 2008; De Conti et al., 2013a; De Paula and Alves, 2000; Dymski, 1999; Kaltenbrunner, 2015b; Kregel, 2001; Palma, 1998; Ramos, 2017).

Despite the relevance of this point, few empirical studies investigated this asymmetric behavior in detail. Among them, the most important are Aizenman and Sun (2012) and Hossfeld and Pramor (2018). Aizenman and Sun (2012) analyzed the role of financial and trade factors to understand the evolution of different "exchange rate market pressure" indices (EMP) before and during the 2008 crises in DEEs. Using quarterly data from 28 DEEs, they divide their sample between the periods before and during the 2008 crisis and estimate a fixed-effects panel model to analyze the relationship between EMP and commercial and financial variables. They find evidence that the relationship between financial variables like short-term external debt as a proportion of the GDP and net portfolio debt inflows and the different EMP measures they used was higher during the global financial crisis than in the early 2000s.

Hossfeld and Pramor (2018), on the other hand, investigated the relationship between several global liquidity indicators and the EMP in a group of 32 DEEs. Using monthly observations between 1995 to 2015, they estimated fixed-effects panel models to analyze the relationship between 15 indicators of global liquidity and EMP in these countries. Their global liquidity indicators are composed of monetary aggregates in central economies, credit indicators, and funding liquidity indicators. They found evidence that higher liquidity in international markets is associated with appreciation pressures on DEEs' currencies. They also use a regime-specific panel model to analyze whether this relationship remains the same during periods of high risk in international markets (measured as months in which the VIX was on its upper 90th quantile) as they are in regular periods. Within their regime-specific regressions, they find evidence that only the relationship between VIX and their EMP index remains significant at higher VIX periods.

Moreover, the coefficient associated with this variable is six times higher in these periods of financial turmoil than in usual times, with the coefficients that connect the rest of the liquidity indicators with EMP becoming statistically equal to zero.

These works shed light on a crucial aspect of the asymmetry of the cycle: the movements of variables like capital flows are more intense in the reversal of the global liquidity cycle than at its ascendant phase. However, there is another asymmetric feature connecting the GLC with DEEs' currencies that lurks behind these developments: a given amount of capital outflows, for example, should have a higher price impact on the currencies of DEEs than the same amount of capital inflows. The reasoning is simple and related to the nature of the supply and demand of foreign currencies in these economies. During the ascendant phase of the cycle, non-resident investors are net suppliers of foreign currencies in these markets, while the demand for these resources comes mostly from domestic agents. In the downturn of the cycle, non-resident investors either reduce their net supply of foreign currencies or even become net demanders in the markets. At the same time, the domestic demand for foreign currencies remains relatively fixed (at least in the short-run). This process will be more severe if the DEE in question is dependent on primary exports since commodity prices tend to fall together with the increase in global liquidity preference, amplifying the supply shock in the foreign exchange markets. This latter asymmetric aspect of the relationship between the global liquidity cycle and the currencies of DEEs is the main focus of this paper.

3.4 Data and Model specification

To investigate the relationship between the global liquidity cycle and the exchange rate markets of DEEs, we analyze a sample of 25 countries.[7] They were selected based on two criteria: i) they should appear at least twice in the nine lists of emerging markets that we consulted; ii) their country-level data is complete for all analyzed time series. We gathered annual observations from 2003 to 2017 for the domestic control variables, and from 2004 to 2018 for the global liquidity cycle variables. For the EMP indices, observations between 2003 and 2018 are used since the first observation is lost due to differencing. A complete description of the selection criteria of countries and the data is presented in Appendix 3.A, Table 3.A.1.

The estimated models have the following structure:

$$EMP_{i,t} = \alpha_i + \beta DV_{i,t-1} + \gamma^{+} Z^{+} GLC_{i,t} + \gamma^{-} Z^{-} GLC_{i,t} + \epsilon_{i,t} \tag{3.1}$$

[7]The 25 countries included in the analysis are Argentina, Brazil, Chile, Colombia, Czechia, Egypt, Hungary, India, Indonesia, Israel, South Korea, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, and Ukraine.

where EMP is the respective exchange rate market pressure index, α_i is the fixed-effects constant variable for each country i, DV is a set of domestic control variables included with one lag, $Z^{+}GLC_t$ and $Z^{-}GLC_t$ are the Z-decomposition of the global liquidity cycle indicator, included contemporaneously. The Z-decomposition divides the GLC variable into its positive and negative component, following the methodology of Allison (2019). We briefly discuss this methodology in Appendix 3.B. The variables are then centered around their country-level mean and estimated using OLS. We estimate four models for each EMP index, using one global liquidity indicator at the time.

To capture the relationship between the GLC variables and foreign exchange markets in the group of DEEs from different angles, we adopted the concept of exchange rate market pressure indices in the paper. The main advantage of using these indices is that they incorporate in a single index the exchange rate variation – the realized outcome of the pressures in the exchange rate markets – and the variation of international reserves. The latter captures the response of monetary authorities to the pressures on the foreign exchange markets. It was first proposed by Girton and Roper (1977) to analyze the relationship between monetary policy variables in the US and the Canadian foreign exchange market. We employ three different definitions of EMP that include either the exchange rate variation or the exchange rate variation together with the variation of the international reserves in our estimations. However, we only discuss the EMP1 definition – that considers the log-variation of the exchange rates alone – in the body of the paper.[8] This definition has the advantage of its straightforward economic interpretation:

$$EMP1_{i,t} = 100 * \Delta ln(E_{i,t}) \tag{3.2}$$

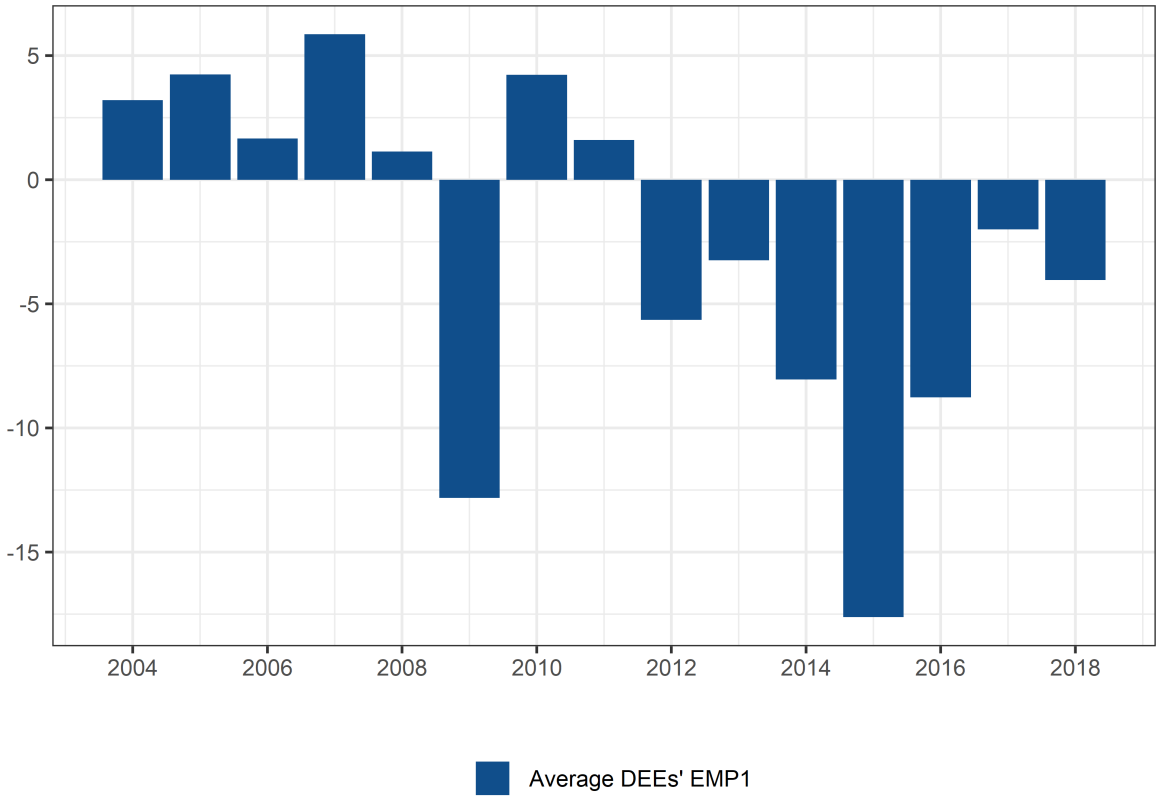
Where E is the bilateral exchange rate with the USD. We multiply the log-variation of the exchange rates by 100 to express it in index points. The average-DEE annual value of the EMP1 index between the 25 countries is presented in Figure 3.3. As we can see, it was mildly positive before the global financial crisis in 2008, and it fell abruptly in 2009. It then rebounded for two years and started falling again in 2012. It is interesting to note that the sharpest decrease of the EMP1 index was not in 2009 but 2015.[9] A comparison between Figure 3.3 and Figure 3.C.1 shows that the exchange rate market pressure before 2008 was significantly higher when one considers the accumulation of international reserves, which indicates that the average DEE resisted the appreciation of

[8]We discuss the pros and cons of different EMP definitions in Appendix 3.C, together with the presentation of the two alternative definitions.

[9]Since the worst phase of the global financial crisis comprised the last quarter of 2008 and the beginning of 2009, the average annual exchange rates averaged out part of the extreme variation related to the crisis. Thus, part of this result is a consequence of a statistical artifact. Nonetheless, it also reflects the impact of the fall of commodity prices that started in 2014 and the tapering of quantitative easing policies on the DEEs. Differently from what happened in 2009, both the price of commodities and capital flows stabilized did not bounce back to pre-2015 levels.

its currency prior to the 2008 crisis. Furthermore, it also reveals that the average DEE refused to use its international reserves during the 2008 crisis.

Figure 3.3: EMP1 index (average of the 25 countries included in the sample, 2004-2018)



Author's elaboration.

To isolate the effects of the GLC on the different EMP indices, we included a set of domestic control variables in the model. These are the variation of the consumer price indices (*cpi*), the current account balance as a percentage of total exports (*cabex*), the annual growth rate of real GDP (growth), government budget deficit as a percentage of the country's GDP (*def*) and the short-term external debt as a proportion of total reserves (*edebt_res*). From these variables, cabex is the most clearly related to the EMP indices, and we expect it to have a positive correlation with it. The short-term external debt as a proportion of the international reserves is associated with the "Greenspan-Guidotti" rule[10] and aims to capture the solvency constraint faced by these economies (Gonzalez, 2007). EMP indices are typically negatively correlated with this variable. There is no consensus about the relationship of the remaining variables with the EMP indices. However, a positive coefficient for the inflation rates and government deficit would be more surprising than otherwise. Overall, we include the control variables to identify the relationship between the global liquidity cycle variables and the EMP indices. Hence, a more in-depth

[10]The "Greenspan-Guidotti" rule states that a country's international reserves should at least match its short-term external debt.

investigation of them is outside the scope of the paper. To avoid simultaneity problems, we include the control variables with a lag.

To capture the relationship between the global liquidity cycle and the EMP indices of the DEEs, we use four variables: the VIX index, a commodity prices index, the liability financial flows to the group of DEEs, and the liability portfolio financial flows to the same countries. Since the relationship between these variables is immediate, these variables are included contemporaneously in the regressions.

The VIX (*vix*) is a standard indicator of global liquidity preference (or the inverse of risk-appetite to use the mainstream jargon) in empirical analyses (Ramos, 2016; Rey, 2015). We expect a negative correlation between the VIX and the EMP measures since hikes in the VIX are associated with higher global liquidity preference and, therefore, capital flights from DEEs. The inclusion of commodity prices is standard in the literature, although this variable is usually treated as a trade-related variable (Aizenman and Sun, 2012; Hossfeld and Pramor, 2018). We expect the commodity prices index to be positively related to the EMP measures since higher commodity prices are associated with the upper phases of the liquidity cycle.

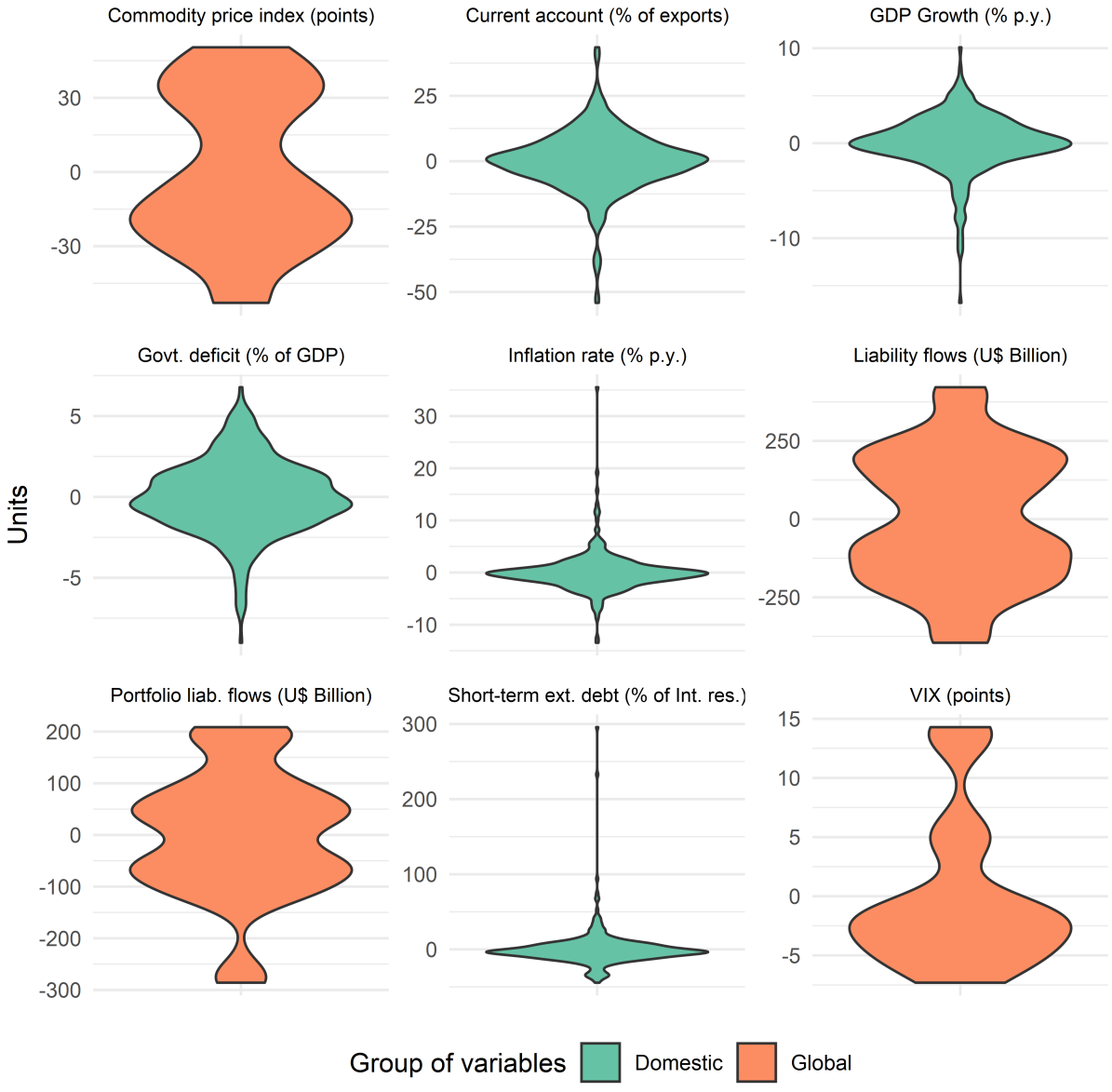
The third GLC variable included is the liability' financial flows (flows) to DEEs. This variable is the sum of the liability' portfolio, direct investment flows, and other investment flows to each DEE in the sample, and its utilization is standard in the literature (Biancareli, 2009; Borio, 2019; De Conti et al., 2013a; Rossi, 2016). To avoid endogeneity issues, we measure this variable as the sum of the liability financial flows to every other country in the sample, as adopted by Blanchard et al. (2017, 2015). For example, the total liability flows series for Argentina is the sum of the financial flows to every country in the sample except for Argentina. The financial flows to other DEEs should be positively correlated to the EMP measures since they are an indicator of the upper phase of the liquidity cycle. Finally, the last GLC variable included in the models is the portfolio liability' financial flows to DEEs (*port_flows*). We include this variable to check if there is any difference in the behavior of portfolio liability flows in comparison to the total financial flows' indicator. This variable is also measured as the portfolio flows to every other country in the sample to avoid endogeneity problems. The portfolio liability' flows to DEEs should be positively correlated with the EMP indices.

Figure 3.4 displays the distribution of the regressors (already centered around their country-level means.[11]) For instance, it is possible to see that the commodity index was 30 index points above or below its average quite often and that the portfolio liability' financial flows were 200 billion USD below its average more than once in our sample. The magnitudes presented in Figure 3.4 help interpret the regression coefficients in section 3.5. It is interesting to note that the domestic control variables, depicted in green in Figure

[11]Since the *comm* and *vix* variables are the same for every country, they are centered around their means.

3.4, are roughly concentrated around their means – except for outliers, particularly on the inflation rates and on the short-term external debt variables. On the other hand, the global liquidity cycle variables, depicted in orange, have a roughly bimodal distribution, with the observations concentrated either above or below their respective means. The VIX has a more peculiar distribution since most of its observations are below its average value. This distribution is a consequence of the few observations that were significantly above its average value. Overall, Figure 3.4 highlights the importance of testing whether the response of the dependent variables is the same for the positive or negative values of the GLC indicators.

Figure 3.4: Violin plot of explanatory variables, centered around their country-level means



Author's elaboration.

3.5 Econometric estimations

Before analyzing the asymmetric coefficients, we must first test whether they are statistically different from each other. As can be seen in Table 3.D.1 in Appendix 3.D, there is enough evidence to reject the null hypothesis of no asymmetric effect for all of the GLC variables.

The first four columns of Table 3.1 present the results of the symmetric regressions.[12] These estimations provide a benchmark to analyze the asymmetric model. Regarding the global liquidity indicators, the VIX variable has the expected sign but is statistically equal to zero. This result is unexpected, given the importance of this variable in the literature, but not surprising given the correlation map analyzed in section 3.2. The commodity price index is significant and has the expected positive sign. Finally, both capital flows' indicators are significant and have a positive coefficient as expected.

On the side of the domestic control variables, no statistical association was found between the short-term external debt and the EMP indices nor between inflation rates and the EMP indices. Higher past growth rates and prior positive current account balance as a percentage of total exports were positively associated with the EMP indices. The most surprising result is the positive coefficient for the government deficit variable. However, except for the cabex variable, the domestic control variables are not robust to different combinations of countries in the sample nor to different combinations of control variables included in the model. Therefore, one has to take these coefficients with a grain of salt.

The last four columns present the results of the asymmetric regressions. All coefficients that capture the negative turn of the global liquidity cycle (*VIX_zpos, comm_zneg, flows_zneg, and port_flows_zneg*) are statistically different from zero at the 1% significance level. Furthermore, these coefficients are numerically larger than their counterpart in the positive phase of the GLC and bigger in absolute values than their symmetric counterpart.

The results associated with the VIX variable illustrate the importance of disaggregating the positive and negative variations of the GLC variables. As can be seen in the fifth column of Table 3.1, there is enough evidence to reject the null hypothesis that positive changes in the VIX index and the EMP1 index are not statistically associated. Our estimations suggest that a VIX variation ten points above its average value is associated with an EMP1 index approximately 2 points below average, ceteris paribus. A similar but negative variation of the VIX variable is not statistically related to the EMP1 in our sample. These results suggest that only positive changes of the VIX are relevant to understand the exchange rate market pressure in DEEs.

[12] All the models were estimated using the *plm* package in R (Croissant and Millo, 2019). The reported p-values were computed using robust standard errors to heteroskedasticity and serial correlation using the *clubSandwich* R package (Pustejovsky, 2019).

Table 3.1: Estimation results for EMP1: symmetric and asymmetric models

	EMP1 (Symmetric)				**EMP1 (Asymmetric)**			
cabex	0.4371***	0.4521***	0.4503***	0.4403***	0.3604***	0.3698***	0.3668***	0.3618***
	(0.0908)	(0.0926)	(0.0905)	(0.0899)	(0.0871)	(0.0818)	(0.0832)	(0.0822)
cpi	0.1297	0.1514	0.1890	0.1352	−0.0001	0.0160	0.0716	−0.0011
	(0.1342)	(0.1322)	(0.1373)	(0.1242)	(0.1225)	(0.1121)	(0.1178)	(0.1124)
def	0.6761***	0.6976***	0.7369***	0.6674**	0.6684***	0.7251***	0.7162***	0.6949***
	(0.2549)	(0.2655)	(0.2686)	(0.2662)	(0.2323)	(0.2313)	(0.2426)	(0.2359)
edebt_res	−0.0251	−0.0223	−0.0175	−0.0212	−0.0406	−0.0400	−0.0340	−0.0374
	(0.0712)	(0.0723)	(0.0714)	(0.0703)	(0.0677)	(0.0681)	(0.0669)	(0.0662)
growth	0.7586***	0.7658***	0.8687***	0.8485***	0.4192***	0.3651***	0.5069***	0.5080***
	(0.1269)	(0.1404)	(0.1524)	(0.1169)	(0.1119)	(0.1076)	(0.1216)	(0.0934)
vix	−0.0419							
	(0.0481)							
comm		0.0329***						
		(0.0127)						
flows			0.0099***					
			(0.0017)					
port_flows				0.0081**				
				(0.0037)				
vix_zpos					−0.2097***			
					(0.0683)			
vix_zneg					−0.0775			
					(0.0484)			
comm_zpos						0.0203*		
						(0.0123)		
comm_zneg						−0.0875***		
						(0.0159)		
flows_zpos							0.0092***	
							(0.0014)	
flows_zneg							−0.0164***	
							(0.0024)	
port_flows_zpos								0.0050
								(0.0035)
port_flows_zneg								−0.0139***
								(0.0037)
R^2	0.2495	0.2584	0.2891	0.2570	0.3035	0.3400	0.3585	0.3228
Adj. R^2	0.1840	0.1937	0.2271	0.1922	0.2406	0.2804	0.3005	0.2616
Num. obs.	375	375	375	375	375	375	375	375

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Robust standard errors in parentheses.

Regarding the liability flows coefficients, both are statistically significant, but the negative flows coefficient is almost twice as large as the positive coefficient. Our estimations suggest that a 200 billion USD inflow to DEEs is associated with an EMP1 index 1.8 points above its average. At the same time, an outflow of the same magnitude is associate with an EMP1 index 3.2 points below its average. The negative coefficient is also approximately 60% larger in absolute terms than the symmetric coefficient for this variable. In the case of portfolio liability flows, only the negative estimate (*port_flows_zneg*) is statistically significant. This coefficient is almost three times larger than the positive coefficient of this variable.

The commodity prices indicator presents a similar behavior, with only the negative coefficient being statistically significant. Our estimates suggest that a year in which the commodities prices index was 30 points below its average value was associated, ceteris paribus, with an EMP1 index 2.4 points below its average variation. In contrast, a year in which the commodity price index had a similar but positive magnitude was only marginally significant and four times smaller than its negative counterpart. It is interesting to note that the relationship between the commodities prices index and the exchange rates of the group of DEEs in the period analyzed is quite similar to the relationship between the other variables usually associated with the global liquidity cycle.

The estimations using EMP2 and EMP3 as the dependent variable, presented in Appendix 3.E, are roughly similar to the ones shown in Table 3.1. The main difference is with the coefficients associated with the commodity index in the regressions with EMP2 as the dependent variable. With this definition, the coefficient of *comm_zpos* is significant and has an unexpected negative sign, while the estimate of *comm_zneg* is statistically insignificant. Nonetheless, these coefficients are not robust to different country subsamples. Similarly, the coefficient associated with *comm_zneg* in the EMP3 is significant and has the expected sign as in the main regression, but it is not significant to different country subsamples.

3.5.1 Robustness checks

One of the limitations of working with macroeconomic variables in a panel data context is that one or a couple of countries might drive the point estimates and the statistical significance of the coefficients. Therefore, it is vital to check the robustness of the results to different subsamples of countries. To implement these checks, we re-estimated the models using different subsamples of countries taken from the 25 countries included in the main regressions to check whether the exclusion of one or a few countries alters the results significantly.[13] If this is the case, the results might be biased by the presence of outliers.

[13]These tests are inspired by the concept of cross-validation widely used in Machine Learning.

The results of these tests for the models estimated using the EMP1 index as the dependent variable are presented in Table 3.2. To understand this table, one should keep in mind that the main sample has 25 countries. With this number of countries, it is possible to make 25 different combinations (n) of 24 countries. Therefore, we subsampled the original data for each of these combinations and estimated the respective models, precisely as we did for the main estimations. We report four statistics: the minimum, the maximum, and the average estimated coefficient for each variable, and the proportion of times that each variable was significant across the 25 different models at the 5% significance level using robust standard errors. We then repeated the procedure but limited the subsamples to 23 countries, which resulted in 300 possible combinations using this size of subsamples. In the last four columns, we present the results for the subsamples containing only 20 countries. Since the total number of different combinations of 20 countries from a universe of 25 countries is 53,130, we limited the estimations to 1,000 random samples of 20 countries extracted from these possibilities.

Table 3.2: Robustness to outliers' tests for EMP1

	24 countries				**23 countries**				**20 countries**			
	n = 24				**n = 300**				**n = 1000**			
Regressor	min	max	mean	signif. (%)	min	max	mean	signif. (%)	min	max	mean	signif. (%)
comm_zneg	-0.09	-0.08	-0.09	100	-0.10	-0.07	-0.09	100	-0.11	-0.06	-0.09	100
comm_zpos	0.01	0.03	0.02	8	0.01	0.03	0.02	11	0.00	0.04	0.02	18
flows_zneg	-0.02	-0.02	-0.02	100	-0.02	-0.01	-0.02	100	-0.02	-0.01	-0.02	100
flows_zpos	0.01	0.01	0.01	100	0.01	0.01	0.01	100	0.01	0.01	0.01	100
port_flows_zneg	-0.02	-0.01	-0.01	100	-0.02	-0.01	-0.01	100	-0.02	-0.01	-0.01	100
port_flows_zpos	0.00	0.01	0.00	0	0.00	0.01	0.00	4	-0.00	0.01	0.00	9
vix_zneg	-0.10	-0.05	-0.08	4	-0.12	-0.03	-0.08	10	-0.15	-0.00	-0.07	13
vix_zpos	-0.26	-0.18	-0.21	100	-0.27	-0.15	-0.21	100	-0.31	-0.11	-0.21	94
cabex	0.31	0.41	0.36	100	0.26	0.46	0.37	100	0.21	0.54	0.37	100
cpi	-0.10	0.13	0.02	0	-0.16	0.17	0.02	0	-0.22	0.27	0.02	1
def	0.52	0.84	0.70	100	0.41	0.92	0.70	99	0.23	1.07	0.69	85
edebt_res	-0.08	0.04	-0.04	4	-0.10	0.05	-0.04	7	-0.12	0.06	-0.03	13
growth	0.25	0.55	0.44	100	0.18	0.59	0.44	99	0.09	0.67	0.42	94

Looking at Table 3.2, we can see that the models are robust to the removal of one or two countries from the sample since the significant coefficients are virtually the same as in the main model. It is also interesting to note that the average point estimates are stable and similar to the point estimates obtained with the full sample. However, when we randomly removed four countries from the sample, the results slightly changed. Regarding the GLC variables associated with the descendant phase of the cycle, the *vix_zpos* variable was significant in only 94% of the models. Regarding the positive variation of commodity prices, removing countries slightly increases the percentage of the time when this variable

is significant at the 5% significance level. However, this variable remains weakly associated at best with the EMP1 variable in our samples. Looking to the domestic variables, one can see that the government deficit (def) variable is not robust to subsampling since dropping four countries reduces the percentage of models in which it is significant at the 5% significance level to only 87% of them.[14]

Finally, to account for the Leamer (1983) critique, we tested the sensitiveness of our results to all possible combinations of domestic control variables,[15] including the case with no domestic control variable. These tests are presented in Table 3.3. All the GLC variables associated with the descendant phase of the cycle are significant in every combination of variables tested. The same is true for the cabex variable, and the range of the estimated coefficients is also reasonably narrow and consistent with the coefficients presented in Table 3.1. The other significant control variables on the main model are not robust to different specifications.

Table 3.3: Sensitiveness tests for EMP1

Regressor	min	max	mean	signif. (%)	total appearances
comm_zneg	-0.09	-0.09	-0.09	100	31
comm_zpos	0.00	0.02	0.01	0	31
flows_zneg	-0.02	-0.02	-0.02	100	31
flows_zpos	0.01	0.01	0.01	100	31
port_flows_zneg	-0.02	-0.01	-0.01	100	31
port_flows_zpos	0.00	0.01	0.00	0	31
vix_zneg	-0.10	-0.04	-0.07	3	31
vix_zpos	-0.35	-0.20	-0.28	100	31
cabex	0.31	0.38	0.34	100	60
cpi	-0.22	0.07	-0.10	3	60
def	-0.18	0.76	0.22	28	60
edebt_res	-0.06	-0.03	-0.05	0	60
growth	0.03	0.54	0.24	23	60

[14] An inspection of the def variable based on this robustness check shows that Nigeria and Russia are present in less than half of the cases in which def is not significant at the 95% level. At the same time, Argentina is present in all of them. Excluding the first two countries render the variable insignificant at the 95% level while excluding Argentina makes it significant again. These results indicate that these countries have a disproportionate influence on the overall result.

[15] There are 31 possible combinations of variables for each GLC indicator, counting with the case in which no domestic control is included. Each of the domestic control variables appears 15 times in each of these 31 combinations. Hence, each of them appears 60 times when we aggregate the models estimated with the 4 GLC variables.

3.6 Final remarks

This paper highlighted the relationship between the global liquidity cycle and the exchange rate market pressure in DEEs. We presented robust evidence that the change in exchange rates associated with the variation of global liquidity cycle indicators in the descendant phase of the cycle in DEEs tends to be more intense than the appreciation of the exchange rates during the upper phase of the cycle. In other words, there is evidence that the relationship between these variables is asymmetric.

The stability of the coefficients in the different subsamples of countries indicates that the connection between the global liquidity cycle and DEEs' exchange rates is a structural characteristic of the contemporary IMFS that affects these countries regardless of their fundamentals, which corroborates the hypothesis of the growing financialization of the exchange rates in DEEs. Furthermore, our evidence suggests that the retrenchment of the global liquidity cycle, as captured in our estimations, have a higher impact on the currencies of these economies than during its expansionist phase. This empirical evidence is in line with the Minskyan interpretation of exchange rate cycles in DEEs. A more granular empirical research that delves into the country-specific details to identify the differences between the DEEs remains as an avenue for future research.

The main policy recommendation that arises from our analysis is that monetary authorities in DEEs should take advantage of the periods of global bonanza to avoid the buildup of external fragilities that can limit their policy space during the downturn of the cycle. Although an in-depth discussion of these policy recommendations is outside the scope of this paper, the experience of the DEEs in the 2000s suggests that, at a minimum, the authorities must accumulate international reserves and avoid the buildup of currency mismatches if they want to limit the contractionary impact caused by the reversal of the cycle. Nevertheless, these policies alone may not be enough. Thus, the regulation of unstable financial flows with measures to defend the external competitiveness of these economies might also be needed.

Appendix

3.A Data description

Table 3.A.1 presents a summary of the sources and definitions of the data used in this paper.

Table 3.A.1: Summary of data sources and definitions

	Freq. (Aggregation)	Range	Unit (raw)	Unit (estimations)	Source	Code / website
EMP						
Exchange rate	A	2003-2018	US$/LMU	US$/LMU	IMF-IFS	EDNA_USD_XDC_RATE
International reserves	A	2003-2018	Current US$	Annual % var.	WB	FI.RES.TOTL.CD
Multilateral loans, IMF, short-term	SA (Last Q4)	2003-2018	Current US$		WB	Q.1C0.1C0.C.9B.IFI.LMIM.1.STR.NV.SDR.MOA
Domestic variables						
Short-term External debt	A	2003-2017		(% of int. reserves)		
- Debt securities held by nonresidents, short-term	SA (Last Q4)	2003-2017	Current US$		WB	Q.1C0.1C0.C.9E.ALL.DSTT.1.STO.MV.TO1.ALL
- International debt securities, short-term	SA (Last Q4)	2003-2017	Current US$		WB	Q.5B0.5B0.M.3P.ALL.DSIT.1.STR.NV.TO1.ALL
- Liabilities to BIS banks, short-term	SA (Last Q4)	2003-2017	Current US$		WB	Q.5B0.5B0.C.5A.BKC.ASTT.1.STR.MX.TO1.ALL
- Multilateral loans, IMF short-term	SA (Last Q4)	2003-2018	Current US$		WB	Q.1C0.1C0.C.9B.IFI.LMIM.1.STR.NV.SDR.MOA
International reserves	A	2003-2018	Current US$	Annual % var.	WB	FI.RES.TOTL.CD
Consumer price index	A	2003-2017	Annual % var.	Annual % var.	IMF-WEO	www.imf.org/external/datamapper/datasets/WEO
Consumer price index (Arg.)	A	2003-2017	Annual % var.	Annual % var.	BIS	www.bis.org/statistics/full_webstats_long_cpi_dataflow_csv.zip
GDP growth	A	2003-2017	Annual % var.	Annual % var.	IMF-WEO	www.imf.org/external/datamapper/datasets/WEO
Cabex				(% of exports)		
- Current account balance	A	2003-2017	Current US$		WB	BN.CAB.XOKA.CD
- Exports	A	2003-2017	Current US$		WB	BX.GSR.GNFS.CD
Govt. Deficit	A	2003-2017	(% of GDP)	(% of GDP)	IMF-WEO	www.imf.org/external/datamapper/datasets/WEO
Global variables						
Liability flows	A, Q	2004-2018				
- Direct Investment	A, Q	2004-2018	Million US$	Billion US$	IMF-BoP	BFDLXF_BP6_USD
- Portfolio Investment	A, Q	2004-2018	Million US$	Billion US$	IMF-BoP	BFPLXF_BP6_USD
- Other investments	A, Q	2004-2018	Million US$	Billion US$	IMF-BoP	BFOLXF_BP6_USD
VIX	D (Y mean)	2004-2018	Index	Index	FRED	VIXCLS
Commodities index	D (Y mean)	2004-2018	Index, 2016=100	Index, 2016=100	IMF	www.imf.org/en/Research/commodity-prices

To be as agnostic as possible in the selection of the countries that we included in the analysis, we selected only those that appeared at least twice in the nine different lists in the Wikipedia "emerging markets" entry (https://en.wikipedia.org/wiki/Emerging_market, consulted in February 2020). The lists used are available upon request. From the 39 cited countries, Bulgaria, Iran, Kuwait, Mauritius, and Oman were listed only once and thus excluded from the sample. We also removed Greece because it is part of the eurozone,

and China, given its sheer size and economic relevance. Finally, we excluded Bangladesh, Qatar, Saudi Arabia, Taiwan, United Arab Emirates, Venezuela, and Vietnam due to incomplete data. The 25 countries included in the analysis are Argentina, Brazil, Chile, Colombia, Czechia, Egypt, Hungary, India, Indonesia, Israel, South Korea, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, and Ukraine.

3.B Allison's (2019) method

According to Allison (2019), one implicit assumption made in almost every econometric model is that if a one-unit increase in variable X is associated with a change of B units in variable Y, then a one-unit decrease in variable X will be associated with a change of -B units in Y. Although there are many reasons to suspect the validity of this assumption, there are few methods that address this issue with longitudinal data. Allison (2019) aims to fill this gap, proposing a method to estimate asymmetric relationships between dependent and independent variables in a fixed-effects panel framework. The remaining of this appendix summarizes Allison's 2019 main points.

To understand his methodology, we start from a simple linear panel model:

$$Y_{i,t} = \beta X_{i,t} + \alpha_i + \epsilon_{i,t} \tag{3.3}$$

where β captures the linear relationship between X and Y, α is the typical fixed-effect estimator, and ϵ is the random errors that are assumed to be independent of the variables in the right-hand side of the Equation 3.3 and specific to each period. One way to estimate this model is to take its first differences:

$$Y_{i,t} - Y_{i,t-1} = \beta(X_{i,t} - X_{i,t-1}) + (\epsilon_{i,t} - \epsilon_{i,t-1}) \tag{3.4}$$

The difference scores of the predictor variables are then decomposed into its positive and negative components:

$$X^+_{i,t} = X_{i,t} - X_{i,t-1} \text{ if } (X_{i,t} - X_{i,t-1}) > 0, \text{ otherwise } 0$$
$$X^-_{i,t} = X_{i,t} - X_{i,t-1} \text{ if } (X_{i,t} - X_{i,t-1}) < 0, \text{ otherwise } 0$$

Since the difference between these two components is equal to the difference score,

$$X^+_{i,t} - X^-_{i,t} = X_{i,t} - X_{i,t-1}$$

Equation 3.4 can be generalized as follows:

$$Y_{i,t} - Y_{i,t-1} = \beta^{+} X_{i}^{+} + \beta^{-} X_{i}^{-} + (\epsilon_{i,t} - \epsilon_{i,t-1}) \tag{3.5}$$

Equation 3.5 is important because it allows us to test if $\beta^{+} = -\beta^{-}$. If there is no evidence to reject this hypothesis, we are back to Equation 3.4. The rejection of this hypothesis provides evidence that suggests the existence of asymmetric effects.

Allison (2019) shows that it is possible to derive a data-generating method that arrives in Equation 3.5 if we set $X_{i,t}^{+}$ and $X_{i,t}^{-}$ to be equal to 0 in period $t = 1$, in which $X_{i,t-1}$ is not observed, and apply the following transformation on the X's variables:

$$Z_{i,t}^{+} = \sum_{s=1}^{t} X_{i,t}^{+}$$

$$Z_{i,t}^{-} = \sum_{s=1}^{t} X_{i,t}^{-}$$

Where the Z-operators are the accumulation up to time t of all previous positive and negative changes in X. Allison (2019) then shows that the following model 3.6 implies the difference score model of 3.5:

$$Y_{i,t} = \beta^{+} Z_{i,t}^{+} + \beta^{-} Z_{i,t}^{-} + \alpha_{i} + \epsilon_{i,t} \tag{3.6}$$

where α and ϵ satisfy the usual assumptions of fixed-effects regression models. The estimation of Equation 3.6 with standard demeaned methods arrives in the same coefficients as when Equation 3.5 is estimated with covariance-corrected generalized least squares methods (Allison, 2019).

3.C Exchange rate market pressure indices

The first works that used the concept of exchange rate market pressure included in the indices the variation of the exchange rate together with the variation of international reserves and the variation of the policy interest rate or the variation of the interest rate differential to a reference rate (Eichengreen et al., 1996; Girton and Roper, 1977). When fixed exchange rates were typical in DEEs, it was natural to include the interest rates

in the indices. However, with the widespread adoption of floating rates and inflation targeting regimes in these countries, the utilization of interest rates nowadays concerns mostly price control in these economies. Given that interest rate data are also scarce among the group of DEEs analyzed, we dropped this variable from our analysis.

In general, the EMP index is defined as the aggregation of the percentual variation of each item in the index (e.g., Aizenman and Sun (2012), Eichengreen et al. (1996) and Hossfeld and Pramor (2018) in their baseline estimations). Nonetheless, some authors weight each item by the inverse of their empirical standard deviation (e.g.,Gonzalez (2007)). Since there is no consensus on the best way to measure the EMP, we use three different definitions:

$$EMP1_{i,t} = 100 * \Delta ln(E_{i,t}) \tag{3.7}$$

$$EMP2_{i,t} = 100 * \frac{\Delta ln(E_{i,t}) + \Delta ln(R_{i,t})}{2} \tag{3.8}$$

$$EMP3_{i,t} = 100 * \frac{\frac{\Delta ln(E_{i,t})}{sd_{ln(E_i)}} + \frac{\Delta ln(R_{i,t}))}{sd_{ln(R_i)}}}{2} \tag{3.9}$$

Where E represents the bilateral exchange-rate to the USD, R is the stocks of international reserves, adjusted to remove short-term IMF loans. The exchange rates are measured as the price of each DEE currency in dollars. Therefore, an appreciation/valorization of the exchange rate implies an upward pressure in the index, while a depreciation/devaluation of the exchange rate implies a downward pressure. Similarly, an increase in the stocks of international reserves moves the EMP upwards while a decrease in the stocks of international reserves moves the EMP downwards. We measure the average exchange rate as the average observed value during the year, and the international reserves as stocks at the end of the year.

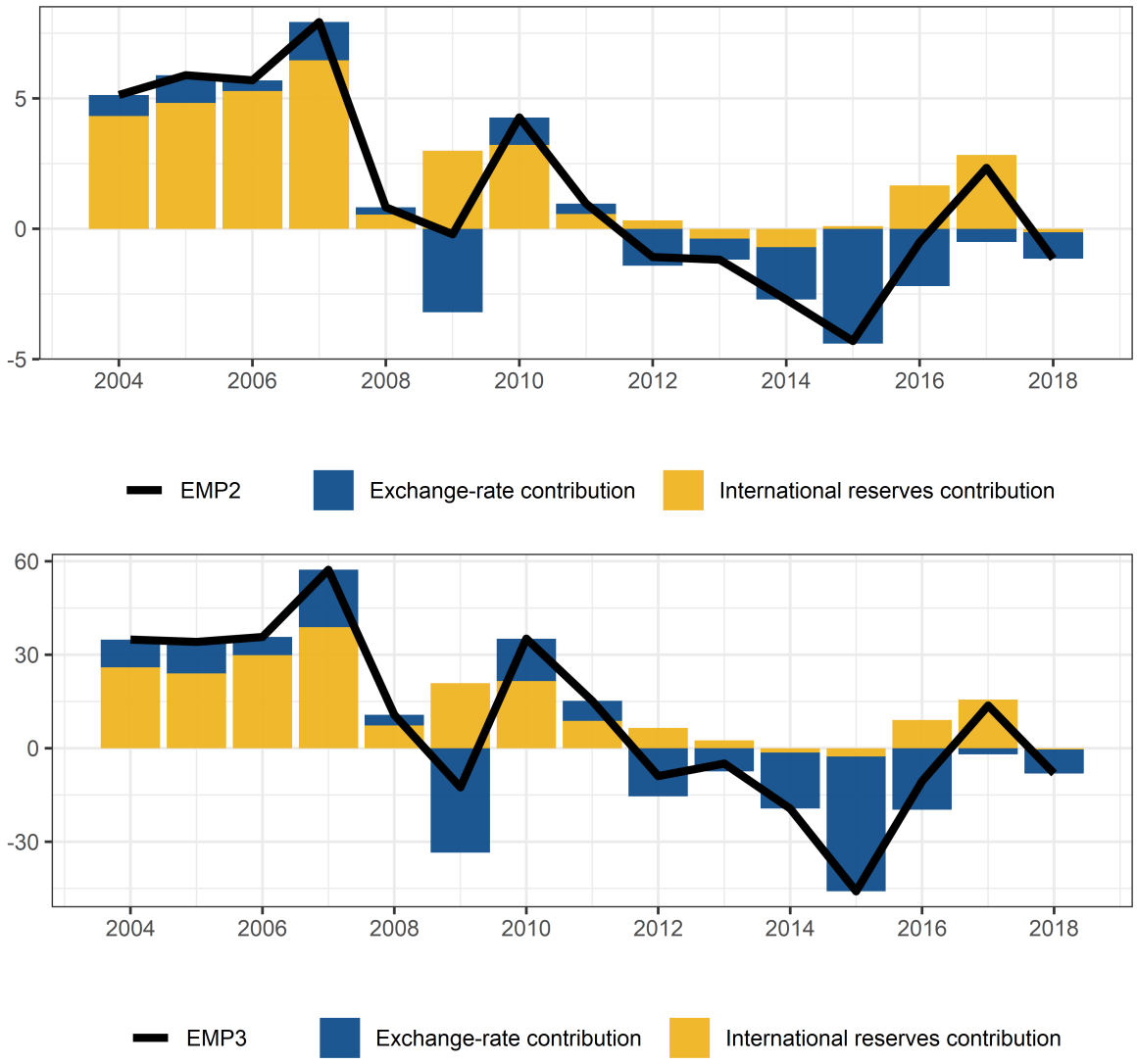
Furthermore, we prefer to use log-changes instead of percentual changes. For small variations, they are approximately the same. However, their values can diverge in the case of substantial variations. Log-changes scale down significant percentual variations, which is a deliberate choice to avoid the substantial percentual variations observed when countries re-establish their international reserves after extreme events of depletion.

In the EMP3 definition, we decided to weight the variables by the inverse of their empirical standard deviation. This decision approximates the contribution of the different items to the index by measuring them in units of their standard deviations. Nonetheless, the EMP2 and EMP3 indices remain reasonably similar. The difference is that the EMP2 index, not normalized, overstates the variation of international reserves, particu-

larly before 2008. Not surprisingly, the EMP indices are all positively correlated. The lowest Pearson correlation statistic measured is the one between EMP1 and EMP2, the definition that gives the most weight to the variation of international reserves, and it is equal to 0.617. The range of values is much higher in the standardized definition. Hence, the coefficients in the models using EMP3 will be larger (in absolute value) than in the non-standardized definitions (EMP1 and EMP2).

It is interesting to compare these two indices with EMP1 (presented in Figure 3.C.1, as they highlight the difference between including or not the variation of international reserves to the EMP index. This difference is most apparent before 2008. In this period, the average DEE significantly hoarded international reserves while its currency only mildly appreciated. Although the highest absolute value of the EMP1 index happened in 2015 (the year with the most significant depreciation of the average DEE' currency), the highest absolute value of the EMP2 and EMP3 happened in 2007, in the height of the pre-crisis bonanza. Similarly, the average DEE currency depreciated significantly in 2009 as a consequence of the global financial crisis. However, the strong monetary policy response in the advanced economies flooded the international capital markets, and the average DEE accelerated the pace of the accumulation of international reserves in 2009. Hence, the negative EMP value in 2009 was smaller (in absolute value) in the EMP2 and EMP3 indices than in the EMP1 index.

Figure 3.C.1: Decomposition of EMP2 and EMP3



Author's elaboration.

3.D Linear hypotheses tests

Following Allison's (2019) methodology, it is essential to test if the asymmetric coefficients in each model are statistically different from each other before analyzing the regression estimates. Table 3.D.1 displays these tests. As it is visible, there is enough evidence to reject the null hypothesis of no asymmetric effects for every GLC variable in all of the models.

Table 3.D.1: Linear hypothesis tests

Hypothesis	**EMP1**	**EMP2**	**EMP3**
vix_zpos + vix_zneg = 0	0.00	0.00	0.00
comm_zpos + comm_zneg = 0	0.00	0.00	0.00
flows_zpos + flows_zneg = 0	0.00	0.00	0.00
port_flows_zpos + port_flows_zneg = 0	0.00	0.00	0.00

3.E Econometric estimations

Table 3.E.1 presents the estimations using the EMP2 and EMP3 indices as the dependent variable. The robustness tests implemented on these models are available at https://github.com/joaomacalos/up-the-stairs-down-the-elevator.

Table 3.E.1: Estimation results: EMP2 and EMP3

	EMP2				**EMP3**			
cabex	0.2299***	0.2504***	0.2570***	0.2526***	1.8140***	1.9374***	1.9524***	1.9056***
	(0.0794)	(0.0778)	(0.0822)	(0.0789)	(0.4240)	(0.4047)	(0.3991)	(0.3811)
cpi	0.3745**	0.3457**	0.4254***	0.3730**	1.3512	1.3794	2.0038**	1.4204
	(0.1594)	(0.1507)	(0.1456)	(0.1570)	(0.9495)	(0.9028)	(0.9148)	(0.9423)
def	0.1313	0.2615	0.2258	0.2279	3.3244**	3.9889***	3.7887**	3.7081**
	(0.2520)	(0.2416)	(0.2486)	(0.2440)	(1.5734)	(1.4975)	(1.5618)	(1.5644)
edebt_res	0.0533***	0.0545***	0.0605***	0.0610***	0.1476	0.1566	0.2115	0.1961
	(0.0163)	(0.0164)	(0.0179)	(0.0160)	(0.1391)	(0.1341)	(0.1380)	(0.1243)
growth	0.2373	0.3173*	0.3542*	0.4248***	1.1190	1.3127	2.0922**	2.3855***
	(0.1789)	(0.1656)	(0.1820)	(0.1465)	(0.8449)	(0.8212)	(0.8601)	(0.7073)
vix_zpos	−0.4435***				−2.6301***			
	(0.1217)				(0.7409)			
vix_zneg	−0.0154				−0.8113			
	(0.0860)				(0.6106)			
comm_zpos		−0.0663***				−0.2291*		
		(0.0229)				(0.1380)		
comm_zneg		−0.0081				−0.4130**		
		(0.0253)				(0.1765)		
flows_zpos			0.0044				0.0623***	
			(0.0028)				(0.0187)	
flows_zneg			−0.0139***				−0.1392***	
			(0.0031)				(0.0230)	
port_flows_zpos				0.0072				0.0536*
				(0.0044)				(0.0318)
port_flows_zneg				−0.0198***				−0.1528***
				(0.0048)				(0.0356)
R^2	0.2661	0.2487	0.2552	0.2647	0.2926	0.2868	0.3249	0.3113
Adj. R^2	0.1997	0.1808	0.1878	0.1983	0.2286	0.2223	0.2639	0.2490
Num. obs.	375	375	375	375	375	375	375	375

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Robust standard errors in parentheses.

Chapter 4

Can domestic non-deliverable forwards replace the sale of international reserves? An analysis of the Brazilian experience[1]

Abstract: In the 2010s, the Brazilian Central Bank (BCB) intervened massively with domestic non-deliverable forwards (DNDFS) to offset the reversal of the global financial cycle. This paper aims to investigate why the BCB used these derivatives instead of selling its international reserves, how they affected the markets, and the limits of these interventions. The main benefit of DNDFs is that they preserve the international reserves of the central bank. Since market makers use these DNDFs to hedge their supply of foreign currencies in the foreign exchange markets, the central bank can affect these markets without spending a dollar. We present evidence that DNDFs were associated with an expansion of market makers' short dollar positions. DNDFs were also used to limit excessive currency volatility. We identified a subset of interventions aimed at offsetting excessive volatility and present evidence that the BCB could stabilize the markets on these occasions. However, DNDFs are not a panacea. If coupled with deregulated foreign exchange markets, frequent interventions may stimulate speculative activity against the domestic currency. Furthermore, they can be costly, and these costs increase the interest-bearing liabilities of the central bank, constraining the domestic policy space of the monetary authority.
Keywords: Emerging economies; Brazil; International reserves; Exchange rate policy; Foreign exchange derivatives.
JEL codes: E44; E58; F31; F36; F65.

[1]The code to replicate this chapter is available at https://github.com/joaomacalos/dndf

4.1 Introduction

In 2013, the Brazilian authorities announced a massive program of systematic intervention with foreign exchange derivatives. It consisted in daily auctions of domestic non-deliverable forwards (DNDFs) – a derivative contract that offers hedging against exchange rate risk – amidst pressures towards the depreciation of the Brazilian real (BRL). The program lasted from 2013 to 2015, and, at its peak, the open position of the Brazilian Central Bank (BCB) in these contracts was equivalent to more than 7% of the Brazilian GDP. The BCB also used these DNDFs in a non-systematic way on different occasions, like after Trump's election in 2016 and the first wave of the Covid-19 crisis in 2020. The utilization of these derivatives contrasts with the virtual lack of depletion of international reserves in the 2010s, revealing a reluctance of the BCB to sell its foreign assets.

Our objectives with this paper are to understand why the BCB intervened with these derivative contracts, how these interventions affected the markets, what are their limitations, and what are the trade-offs involved in using these derivatives instead of selling international reserves. We argue that the main benefit of these instruments is that they can alleviate the pressures in the FX markets without using a dollar since they are settled in the domestic currency. However, they can generate substantial losses to the central bank – constraining domestic monetary policy implementation – and invite speculative activity from abroad.

The paper is structured in four sections, including this introduction. In section 4.2, we discuss the hierarchical structure of the international monetary and financial system (IMFS) and the importance of exchange rate policies in developing and emerging economies (DEEs). Our main contributions are presented in section 4.3, where we analyse the Brazilian experience with DNDFs. This section is divided into three subsections. First, we delve into official documents and press releases to show that the main objectives of the BCB with its DNDF policy were to strengthen hedging markets and offset excessive currency volatility. Secondly, we present empirical evidence that evaluates whether the BCB was successful with its objectives. To assess its role in strengthening hedging markets, we cross data from the B3 – the Brazilian exchange –, with data from the BCB on the foreign exchange position of commercial banks to show that banks' open positions in the foreign exchange markets increased together with the issuance of DNDFs. Next, we assess whether the DNDFs were able to offset excessive speculation by identifying a group of DNDF interventions that offered higher-than-usual coupon rates – a sign that these interventions aimed at affecting the exchange rates – and evaluating the market developments around these interventions. Finally, we analyse the limits of DNDFs and the trade-offs involved in their utilization.

We conclude the paper by arguing that DNDFs can enhance the room for maneuver of peripheral central banks to intervene in foreign exchange markets. However, they can

become a costly policy that invites speculative activity from abroad and increases the interest-bearing liabilities of the central bank. Rather than providing a ladder to climb the global currency hierarchy, the Brazilian experience reveals that these interventions work as firefighters, limiting the damages brought by the subordinated integration to global financial markets.

4.2 Global asymmetries and the importance of foreign exchange policies

A growing process of financialized globalization, with the United States and the U.S. dollar (USD) in a hegemonic position, has marked IMFS since the demise of the Bretton Woods system (Tavares and Melin, 1997). The American hegemony was evident in 2007 and 2008, when a major global financial crisis broke out in the heart of the U.S. financial system but international investors rushed to tuck their investments into USD-denominated assets. In this crisis, the U.S. Federal Reserve also played a pivotal role, acting as a de-facto global lender of last resort to stabilize the global banking system in distress (Gabor, 2020; Helleiner, 2016; Mehrling, 2010; Tooze, 2018). The corollary of this hegemony is that all other currencies are measured against the USD. While central currencies like the Japanese Yen are accepted internationally and thus reasonably close to the USD status, peripheral currencies like the BRL are, in practice, not accepted internationally. Hence, the current configuration of the IMFS is structurally hierarchical (Andrade and Prates, 2013; Cohen, 1998; De Conti et al., 2014; Guttmann, 2016; Kaltenbrunner, 2015b; Prates, 2002).

In this hierarchic world, peripheral countries are in a subordinated position. The lack of currency liquidity impairs the attractiveness of their assets for non-speculative reasons (De Conti et al., 2014). Yet, these markets are hugely affected by the investments made by non-residents, even if they represent only a small fraction of their investments (Prates, 2002, 2005)[2]. Since the liability structure of these investors is mostly denominated in central currencies (USD in particular), they are quite sensitive to what happens in central economies and to the variations of the USD. Anything that threatens to increase its price – e.g., hikes in the American base interest rate or a financial crisis in a particular DEE – can trigger an international flight to safety, disrupting the foreign exchange markets of DEEs and leading to significant currency depreciation (Bonizzi, 2017; Bonizzi and Kaltenbrunner, 2020; Kaltenbrunner, 2015b; Macalós and Rossi, 2020).

At the individual level, the problem of currency depreciation is that it has contractionary economic effects, at least in the short-run (Carvalho, 2018). It affects prices

[2]According to Bonizzi (2017), in October 2013, 1.85% of institutional investors' portfolios were allocated to DEEs bonds and equities; nonetheless, these investments were equal to roughly 21.5% of total DEEs' portfolio liabilities.

through the price of tradables, reducing real wages and thereby the effective demand, and it forces central banks with mandates to control inflation to raise interest rates. Furthermore, even if central banks possess significant amounts of international reserves, companies indebted in foreign currencies can become insolvent due to the sudden increase in the value of their liabilities. Finally, the depreciation of the currency harms import-dependent sectors. The severity of these factors depends on how fast the currency depreciates, how far the depreciation goes, and how vast is the pass-through to prices. These problems are aggravated by the growing dependence of the contemporary financial system on the USD and the existence of a global financial cycle that synchronizes national business cycles worldwide, amplifying these recessive shocks (Rey, 2016; Shin, 2016).

Historically, the IMF and the World Bank offered help to DEEs to bridge their foreign exchange crises. However, the conditionalities imposed by these institutions to extend loans and the domestic reputational costs associated with these loans made DEEs reluctant to accept their assistance (Eichengreen, 2010). The limited firepower of these institutions to deal with a crisis like the global financial crisis also puts in question their capacity. In this occasion, the U.S. Federal Reserve (the Fed) was pushed to intervene directly as a lender of last resort, signing swap agreements with different central banks worldwide to alleviate the global demand for U.S. dollars.

However, the Fed's assistance created problems of its own. According to Sahasrabuddhe (2019), the Fed signed these agreements with countries that shared its capital account openness policies. This author also argues that political and diplomatic preferences mediated the Fed's choice of DEEs partners. Finally, these agreements also place the Fed in a dominant position in relation to its peers. It is thus understandable that DEEs are reluctant to draw on these resources. In Brazil, for example, the announcement of the swap agreement signed with the Fed signalled to the markets that the Brazilian authorities had enough ammunition to defend the Brazilian markets during the peak of the 2008 financial turmoil. However, the Brazilian authorities did not draw on these resources, choosing to use its reserves and derivatives contracts to provide emergency liquidity in its foreign exchange markets (Barroso, 2019; Bastos and Fonte, 2014).

The Brazilian choices illustrate the preference of DEEs to adopt independent solutions. One such policy is the implementation of capital controls, which has received significant attention recently (Ghosh et al., 2018; Ostry et al., 2016; Prates and Fritz, 2013). However, most DEEs are reluctant to use these controls. One reason for this reluctance is political: such controls can hurt powerful financial interests at home and abroad (Rodrik, 2006). Furthermore, it was not until the 2008 crisis that the multilateral institutions somewhat acknowledged their importance (e.g., IMF (2012a)).

Another strategy consists of modulating the perils of financial integration to global markets with direct interventions in foreign exchange markets. The clearest expression of this strategy is the accumulation of international reserves. As Rodrik (2006, p. 265)

argues, the accumulation of reserves does not have the 'unsavoury reputation' of capital controls. With this policy, most DEEs eliminated macroeconomic currency mismatches – net liabilities in foreign currencies –, that were seen as responsible for the severity of DEEs crises in the 1990s (Boyer et al., 2004; Eichengreen et al., 2007). This policy has many benefits. As Feldstein (1999, p. 1) argues, a country with large international reserves and or easy access to loans in foreign currencies is less likely to be targeted by international speculators. They are also the means to deal with sudden stops of capital inflows and domestic capital outflows. In his words, 'liquidity is key to self-protection.'

Nonetheless, the utilization of international reserves to offset capital flights is limited by the stocks of international reserves, and its depletion can be seen as a sign of weakness by global institutional investors (Eichengreen, 2016). Therefore, DEEs are eager to try alternative policies that can be used in these situations without drawing on international reserves. The utilization of foreign exchange derivatives contracts is one possibility since they can address the demand for hedging before it materializes in demand for foreign currency (Barroso, 2019).

However, interventions with derivatives depend on the existence of minimally developed foreign exchange derivatives markets. This is a problem for peripheral countries since the cyclical behaviour of their currencies and their limited attractiveness during periods of distress make the operations in these markets quite risky during periods of capital flights and financial turmoil – exactly when the availability of these markets is most urgent. Therefore, central banks are interested in being the market maker of last resort in FX derivatives markets, preserving the supply of hedging opportunities that is crucial to prevent a balance sheet crisis among private companies indebted in foreign currencies (Farhi, 2001, 2006).

Central banks may also intervene in these markets to prevent excessive speculation (Rossi, 2014). As Franco (2000), a former president of the BCB, argues:

> "A speculator with [BRL] R$ 1 million in government bonds could leverage this amount from eight to thirteen times, for instance, in short positions that communicate instantly to the spot market through arbitrage and swap operations. [...]. The question here is simple: should the central bank face speculators in the spot market, where its actions are limited to the stock of reserves and are at a disadvantage of ten to one, or should it shift the battle to the derivatives exchange where stakes are in reals and leveraging works both ways? Should the central bank be a player in these markets, at least in times of strain, fighting fire with fire?" (Franco, 2000, p. 57).

In this paper, we explore the interventions of the BCB on the derivatives markets with DNDFs. With these contracts, the BCB assumes the exchange rate risk in exchange for the domestic interest income during the validity of the contract. A crucial aspect

of these contracts is that they are completely settled in BRL. Therefore, the BCB can offer exchange rate hedging to market participants without compromising its international reserves. The Brazilian experience with these instruments has been considered relatively successful by multilateral institutions (e.g., Chamon et al. (2019b); Barbosa et al. (2019)) and was replicated by different DEEs like Turkey, Mexico, Peru, Colombia, Dominican Republic, Indonesia, and the Philippines (Chamon et al., 2019a; Gonzalez et al., 2019; IMF, 2021; Schmittmann and Teng, 2019).

To conclude this section, a note of caution is necessary: even if foreign exchange interventions like DNDFs can have an impact in foreign exchange markets, the reversal of the global financial cycle – with its impact on capital flows and commodity prices – will exert significant pressure on DEEs currencies (Akyüz, 2012). Therefore, interventions that target a nominal exchange rate faces a dilemma: the government must increase their scale to sustain the policy, but prolonged interventions are incorporated into the markets' expectations and become less effective. Prolonged interventions may also erode the stocks of international reserves and generate significant financial losses, damaging the credibility of the central bank. That is why the literature emphasizes that these policies have a role to play in smoothing the transition to a new currency level consistent with global conditions but reject its efficacy to sustain by itself a nominal exchange rate level (Chamon and Magud, 2019).

4.3 Brazilian DNDFs policy

4.3.1 Why domestic non-deliverable forwards?

4.3.1.1 Idiosyncratic foreign exchange markets

To understand why the BCB pioneered the utilization of DNDFs in DEEs, we must understand its foreign exchange markets in its historical context. According to Prates (2015), the Brazilian foreign exchange markets are unique and shaped by the economic history of the country. These markets were forged by the external debt and hyperinflationary crises of the 1980s and early 1990s when policymakers' objectives were to concentrate the foreign resources in the hands of the Brazilian state. The policymakers created tight institutional restrictions on the use of foreign currencies inside the national borders. At the same time, the Brazilian Central Bank nationalized most of the private external debt (Tavares and Assis, 1986), creating a precedent for its future policies. This period also witnessed the appearance of a liquid derivatives markets (Dodd and Griffith-Jones, 2007).

A clear segmentation between the spot and derivatives markets emerged from this period. The spot market is tightly regulated, and only authorized institutions can hold accounts denominated in foreign currencies. Furthermore, foreign currencies cannot settle

transactions inside the Brazilian jurisdiction (Prates, 2015). These restrictions prevented the creation of a Brazilian Eurodollar market.

As a consequence of these restrictions, all transactions in the onshore derivatives markets are settled in BRL. This feature allowed the development of a market open to anyone with an account at a financial broker can have access, becoming a natural place to look for hedging opportunities (Bessada et al., 2005; Dodd and Griffith-Jones, 2007; Farhi, 2006; Prates, 2015).

One particularity of the Brazilian onshore derivatives markets is the preponderance of transactions auctioned in the B3 exchange (Rossi, 2016). The most important foreign exchange derivatives traded at the B3 are the Future USD contract in its first maturity, the "*cupom cambial*" – a synthetic USD interest rate settled in BRL – contract that allow the hedging of foreign exchange risk, and call and put options linked to spot USD (Bessada et al., 2005). The volume traded in these markets is around three times larger than in the spot market (Rossi, 2016). Furthermore, many studies have shown that the BRL/USD exchange rate is formed in futures markets and transmitted by commercial banks to the spot market (Dodd and Griffith-Jones, 2007; Garcia and Urban, 2004; Prates, 2015; Rossi, 2016; Ventura and Garcia, 2012).

These factors stimulated the Brazilian authorities to experiment with interventions in the derivatives markets since the 1990s. According to Farhi (2006), these early interventions were responsible for the socialization of the foreign exchange losses after the abandonment of the currency peg in 1999. The BCB incurred substantial financial losses in the period, which led the IMF to forbid the BCB to intervene in these markets in their agreement later that year. However, the BCB was allowed to intervene in these markets again in 2002, now with DNDFs. These interventions were relatively short-lived and faced significant convertibility risks given the low level of foreign assets at the BCB (Garcia and Volpon, 2014). Nonetheless, the 2000s' bonanza allowed the BCB to hoard significant stocks of international reserves, and the next time these DNDFs were used to provide liquidity to the markets – after the Lehman Brothers crisis in 2008 – they were considered quite effective (Barroso, 2019; Bastos and Fonte, 2014). Since then, DNDFs were the favourite instrument of the BCB to intervene when there is pressure against the BRL.

4.3.1.2 The Brazilian DNDF contract

The DNDFs (locally known as "*swaps cambiais*," i.e., FX swaps[3]) offered by the BCB trades the exchange rate variation against the USD plus a synthetic foreign interest rate

[3]We prefer the term "DNDF" to avoid confusion with the "FX swaps" in which two parties agree to exchange two currencies spot and to reverse the exchange at some agreed point in the future (Borio et al., 2017). The literature also refers to these instruments as BCB swaps or Brazilian swaps (Chamon et al., 2019b; Gonzalez et al., 2019).

(the foreign exchange "coupon") for the domestic effective interbank interest rate (tied to the Brazilian policy interest rate). When the BCB takes a short position on USD variation, it is said to issue a "traditional" DNDF contract, while in a "reverse" contract, the BCB takes the opposite position. In other words, when the BCB offers a "traditional" DNDF, it commits to pay to the counterparty the variation of the BRL/USD exchange rate if the BRL turns out to depreciate, while the counterparty commits to pay the BCB if the BRL turns out to appreciate. Therefore, the DNDFs offered by the BCB serve as a hedging instrument against the depreciation of the BRL. In this paper we focus exclusively on "traditional" DNDFs since the BCB only auctioned "reverse" DNDFs in the 2010s to remove "traditional" DNDFs from the market.

These DNDFs are traded at the B3 exchange. They have a notional value of 50,000 USD, but the principal is not delivered at the end of the contract. Furthermore, they offer daily[4] margin adjustments of the different financial returns to keep the notional value of the contract stable. Importantly, the financial settlements that occur during the validity of a DNDF contract are settled in BRL.[5] Therefore, these derivatives are technically referred to as domestic non-deliverable forward contracts (Garcia and Volpon, 2014; Hendrick et al., 2019; Schmittmann and Teng, 2019).

The BCB uses an auction system to negotiate DNDFs, and it is the only agent that can auction these contracts. These instruments are mostly absorbed by domestic financial institutions, as shown in Figure 4.1. Before each auction, the BCB announces the exact time when counterparties can place bids, the maximum quantity of contracts that are in offer, and the maturity of the contracts that it might accept. Bidders can place up to five bids. Yet, every negotiated contract pays the same domestic interest rate and receives the same coupon and exchange rate variation. Furthermore, the volume of contracts accepted (up to the maximum announced) remains at the discretion of the BCB (Nedeljkovic and Saborowski, 2019). The main advantage of issuing DNDFs instead of intervening directly into the futures or forward markets is the tighter control that the BCB has over this market.

4.3.1.3 The reasons behind BCB's interventions

To understand the reasons behind the utilization of DNDFs by the BCB, we rely on documents published by the BCB, on interviews made by its directors, and on Barroso (2019) – a paper written by a former director of the BCB where the author makes a balance of the BCB's experience with foreign exchange interventions.

[4] Until 2013, the contracts available in the B3 specified periodical adjustments defined at the beginning of the contract.

[5] http://www.b3.com.br/en_us/products-and-services/trading/interest-rates/di-x-u-s-dollar-swap.htm

According to the BCB's website (BCB, nd), the BCB "may intervene occasionally to ensure the smooth functioning of the foreign exchange market." The DNDFs "provide an alternative for traders that would demand foreign currency for financial purposes – speculative or hedging – rather than for transaction reasons." The BCB also emphasizes that all DNDF contracts are settled in BRL and have no direct impact on its stocks of international reserves. This explanation clarifies the understanding of the BCB regarding the utilization of its DNDFs. They are useful for providing hedging opportunities to the markets. The BCB also explicitly defends the floating nature of the Brazilian exchange rate regime – thereby rejecting the utilization of FX swaps to target a nominal value of the BRL/USD exchange rate. As it is written on the BCB's website, "[i]t is important to emphasize that these interventions aim at preserving the floating exchange rate regime and the financial stability."

The same reasoning is present in official documents. For instance, the communiqué that announced the program of daily interventions in 2013 stated that the objective of the interventions was "providing foreign exchange hedging to economic agents and liquidity to the foreign exchange markets" (BCB, 2013a). The same wording was repeated when the BCB renewed the program (BCB, 2013b; BCB, 2014). At the end of the program in March 2015, the President of the BCB claimed that the BCB achieved its objectives, allowing the private sector to calmly sail through the depreciation of the BRL in the period (Brasil, 2015).

Barroso (2019) clarifies the reasons behind the BCB's preference for DNDFs. According to this author,

> "the motivation for the [2013-2015 daily-feeding] intervention policy was to avoid panic and allow rational calculations to dominate the adjustment of debt profiles and foreign currency exposures. Spot interventions could have the opposite effect and induce market participants to liquidate positions as soon as possible. Swap interventions create conditions for adjustment, and by the nature of non-deliverable forwards, preserve international reserves for use in case of panic." (Barroso, 2019, p. 106)

He further argues that one key aspect of the daily feeding program was its communication strategy. The BCB announced a "sufficiently large" (Ibid, p. 107) intervention to avoid panic while the "very strict" (Ibid, p. 107) rules-based intervention intended to avoid expressing any preference for the nominal level of the exchange rate.

The BCB and its directors also expressed their concerns about the excessive volatility of the BRL. For instance, the BCB (2015b) commented that the interventions at the end of 2015 aimed not only at increasing the supply of foreign currency but also reducing the volatility in foreign exchange markets. In November 2016, during the turbulent days that followed the election of Donald Trump to the presidency of the United States, the

president of the BCB said to the press that even if the BRL was in a floating exchange rate regime, the central bank must intervene to avoid excessive volatility (Brasil, 2016). In June 2018, the President of the BCB declared to the press that the BCB would use any instrument at its disposal to reduce the volatility of the BRL. This speech was later formalized in a note of the BCB saying that it "did not see any restriction that could prevent the size of open DNDFs positions to considerably surpass the amounts registered in the past" (BCB, 2018). This remark is underscored in the BCB's website.

These claims illustrate that the *raison d'être* of the DNDFs' interventions was to strengthen hedging markets. Occasionally, the BCB can also use these interventions to offset excessive BRL volatility.

4.3.1.4 The transmission mechanism

According to Stone et al. (2009), sterilized FX interventions affect the exchange rates through three channels: i) the order-flow or microstructural channel, ii) the portfolio balancing channel, and iii) the signalling or expectations channel. DNDFs affect the markets through the same channels, but they take place in the derivatives market. Their auction has a direct impact on the coupon rate (synthetic onshore-USD interest rate) and the future exchange rate at the microstructural level (Kohlscheen and Andrade, 2014). The counterparties of these contracts then distribute this liquidity into the foreign exchange markets, affecting the relative supply and demand for foreign currencies (Garcia and Volpon, 2014). Furthermore, such interventions affect the expected returns of holding different currencies and can accommodate some of the portfolio demands of market agents (Stone et al., 2009). Finally, the interventions with DNDFs also have a signalling effect. In the case of systematic interventions, the signalling effect works as forward-guidance. In the case of sporadic interventions, they signal the disposition of the central bank to stop undesirable market movements.

This subsection focuses on the microstructural connection between the Brazilian DNDF market and the rest of the foreign exchange markets. In a nutshell, exchange rates (spot and future) are the prices that clear the foreign exchange markets. They result from the interplay of supply and demand forces that originate from final demanders of foreign exchange. Market makers operate by providing intermediate liquidity to these markets. They play a mostly passive role, accepting orders from final demanders as they come and profit from the bid-ask spread they collect by providing liquidity on both sides of the markets. However, market-making is only profitable if the dealers are not caught off-guard with open foreign exchange positions. Therefore, they must close their open positions, and they do so by adjusting their prices in the direction that would help them keep their inventories balanced (Bouchaud et al., 2018; Harvey, 2009; Lyons, 1995; Mehrling, 2013b).

Market makers can also hedge their positions in markets of different maturities. A key concept to understand such hedging is the covered interest rate parity (CIP) condition, expressed in Equation 4.1:

$$F = S \cdot \frac{1+i}{1+i^*} \tag{4.1}$$

where F is the forward (or futures) exchange rate, S is the spot exchange rate, and i and i^* are the domestic and international interbank rates, respectively. Since the market makers are generally on the favourable side of the bid-ask spreads, they are well-positioned to cover their positions in different markets with a profit (Coulbois, 1979). When market makers cover their positions in markets of different maturities, they diffuse price pressures between these markets.

The BCB takes advantage of these mechanisms with its DNDFs. Since the components of the DNDF contracts are the official BRL/USD exchange rate variation, the FX coupon (henceforth "coupon"), and the domestic interbank interest rate, there is an implicit forward exchange rate associated with each DNDF. The counterparties of these contracts with the BCB can use them to hedge their open foreign exchange positions. This hedging is profitable as long as the implicit future exchange rate embedded in the DNDFs is lower than the USD rate they get their operations.

For example, commercial banks holding DNDFs can increase their sales of future USD contracts without exposing their inventories to exchange rate risk. This expansion, in turn, absorbs the demand for hedging originating from other market participants – e.g., non-resident investors or non-financial corporations. In a counterfactual world without DNDFs, one would expect that the same demand for hedging from market participants would lead to a higher price adjustment for market makers to keep their inventories balanced. Therefore, the BCB uses DNDFs to provide a quantity adjustment to market makers, allowing them to increase their net-short positions in different FX markets.

4.3.2 How did the DNDFs affect the Brazilian markets?

4.3.2.1 Strengthening hedging markets

In subsection 4.3.1.3, we saw that providing hedging opportunities was the main objective of the BCB's DNDF policy. Our goal in this subsection is to analyse whether the BCB achieved this objective in the 2010s.

Despite the emphasis of the BCB on this objective, only Gonzalez et al. (2019) tackled this question directly. These authors present evidence at the firm-level that the DNDFs' interventions of the BCB diminished the impact of the tapering of quantitative easing policies in the U.S. on the Brazilian economy. In particular, they show that the DNDF program partially offset the negative shock inflicted by the taper tantrum in 2013 on the

supply of credit by Brazilian banks. They conclude that the BCB acted as a "hedger of last resort," reducing the currency mismatches in the balance sheets of commercial banks and preserving the local financial conditions.

Albeit interesting, Gonzalez et al. (2019) focus on the effects of the 2013-2015 program on the Brazilian credit supply. We take a different perspective and analyse the effect of BCB's interventions on the hedging markets. Given the transmission mechanism outlined earlier in the paper, we evaluate how the interventions of the BCB connected with the positions of market makers in the Brazilian foreign exchange markets. We expect to see an association between the interventions with DNDFs and the net foreign exchange exposure of market makers on different FX markets.

We rely on two datasets: the information on the open contracts at the B3 by type of participants, available at the B3 website,[6] and the spot position of commercial banks, released monthly by the BCB. The B3 segments the participants in its markets into eight institutional sectors: the BCB, commercial banks, national institutional investors, non-financial corporations, non-resident investors, persons, brokers, and other financial corporations. Since these data can only be queried one day at a time, we web-scraped the B3 website to make a time series from 2009 to 2020.

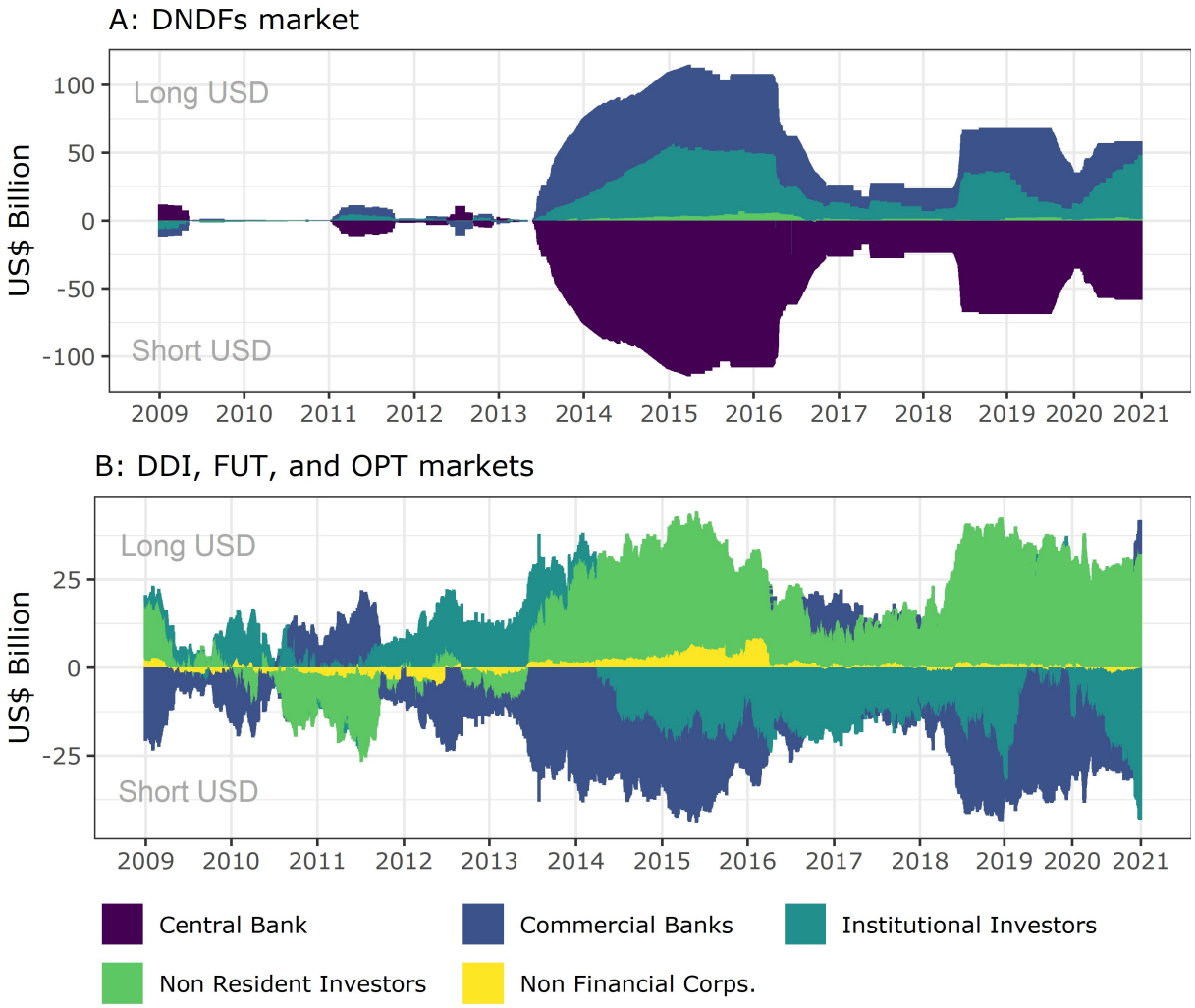
We display the B3 data in Figure 4.1. As shown in panel A, the open position of the BCB with DNDFs increased sharply in June 2013, culminating with the program's announcement in August of the same year. At the end of the program in March 2015, the short USD position of the BCB amounted to 115 billion USD. After a gradual reduction of the open position to a level of around 25 billion USD in 2017, the BCB increased its short USD position to 69 billion USD between May and June 2018, amidst the normalization of the U.S. monetary policy stance, the exchange rate crises in Turkey and Argentina, and the domestic instability associated with the electoral year in Brazil. The BCB auctioned DNDFs again during the first wave of the Covid-19 crisis. At the end of 2020, the short USD position of the BCB was equal to 58.5 billion USD. The main counterparties of the BCB on DNDF contracts were banks and national institutional investors.

On the other side of the bridge, banks and national institutional investors distributed this liquidity on the foreign exchange derivatives markets, as shown in panel B of Figure 4.1.[7] This panel consolidates the net institutional positions in the three main Brazilian FX derivatives markets at the B3: the future USD market (FUT), the USD call and put options market (OPT), and the coupon market (DDI market).

[6] http://www.b3.com.br/en_us/market-data-and-indices/data-services/market-data/reports/derivatives-market/open-interest/by-type-of-member/

[7] It would also be important to look at the forward (OTC) market to have a complete view of the derivative markets. Unfortunately, the data for this market (CETIP) is not publicly available.

Figure 4.1: Net institutional positions on the foreign exchange markets at the B3, 2009-2020



Source: B3.
Author's elaboration.

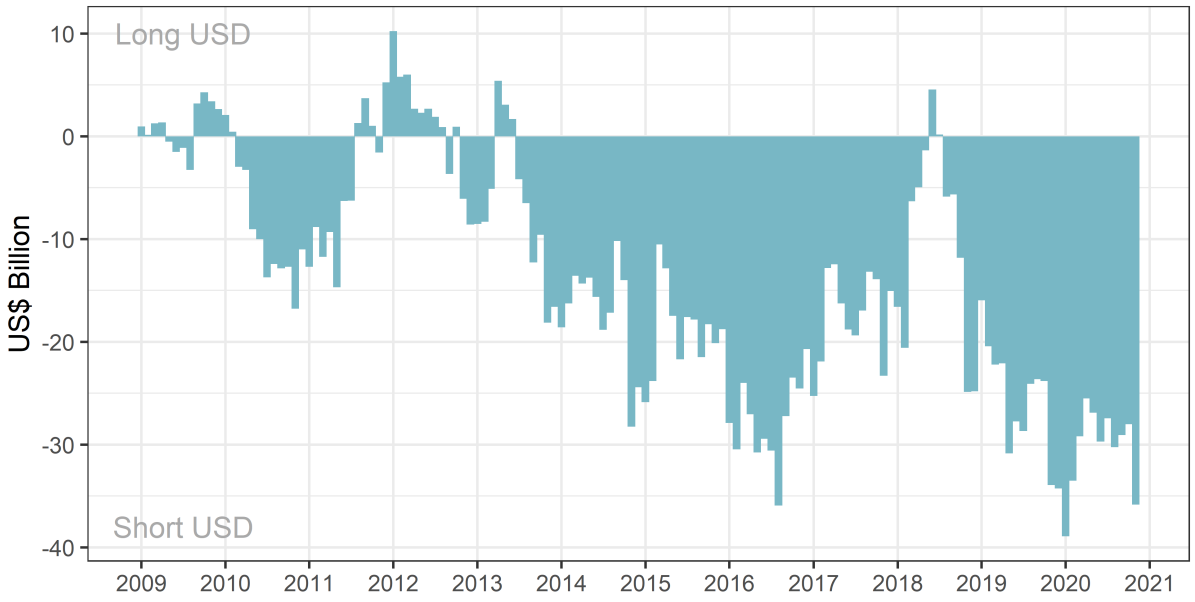
As can be seen, the same counterparties holding long USD positions against the BCB on the DNDF market were the institutional sectors holding short USD in the hedging markets. It is visible how these positions increased together with the interventions of the BCB – especially during the daily-feeding program, but also in 2018.

DNDFs can also stimulate the commercial banks to increase their supply of USD in the spot markets, thereby alleviating FX liquidity pressures on the central bank[8] (Garcia and Volpon, 2014). We present the spot foreign exchange position of commercial banks between 2009 and 2020 in Figure 4.2. As can be seen, their short USD position in the spot markets increased together with their long USD position in DNDFs when the BCB was most active in this market. The fact that commercial banks were holding short USD

[8]The removal of the ceiling – through the Circular 3,659 – over the short USD position of the commercial banks that took place before the start of the intervention program suggests that policymakers were aware of this channel.

positions in all maturities and despite the depreciation of the BRL in the 2010s indicates that they were providing liquidity to the markets as expected by the central bank.

Figure 4.2: Commercial banks' foreign exchange position, 2009-2020



Source: BCB.
Author's elaboration.

A regression of the monthly variation of banks' and institutional investors' net position on foreign exchange derivatives markets and the position of banks on the spot market against the variation of the BCB's position on the DNDF market reinforces the visual association between these variables. These results are presented in Table 4.1. As can be seen, a 1 billion USD increase in the net short position of the BCB on the DNDF market was associated with an estimated increase in the banks' and institutional investors' short USD positions on the FX derivatives markets of 0.168 billion USD and 0.126 billion USD, respectively. Furthermore, a similar increase in the net short position of the BCB in the DNDF market was (weakly) associated with a 0.121 billion USD point increase on the spot FX position of banks.

Table 4.1: Relationship between institutional sectors' positions on the futures and spot markets and the DNDF market, 2009-2020

	Δ Banks (Derivatives markets)	Δ Institutional investors (Derivatives markets)	Δ Banks (Spot market)
(Intercept)	0.039	-0.163	-0.160
	(0.384)	(0.288)	(0.346)
Δ BCB's DNDFs	0.168 ***	0.126 ***	0.121 *
	(0.061)	(0.044)	(0.068)
Δ Institutional investors (Derivatives markets)	-0.791 ***		-0.152
	(0.096)		(0.094)
Δ Banks (Derivatives markets)		-0.430 ***	-0.413 ***
		(0.064)	(0.084)
R^2	0.348	0.349	0.206
Adj. R^2	0.339	0.340	0.189
Num. obs.	144	144	144

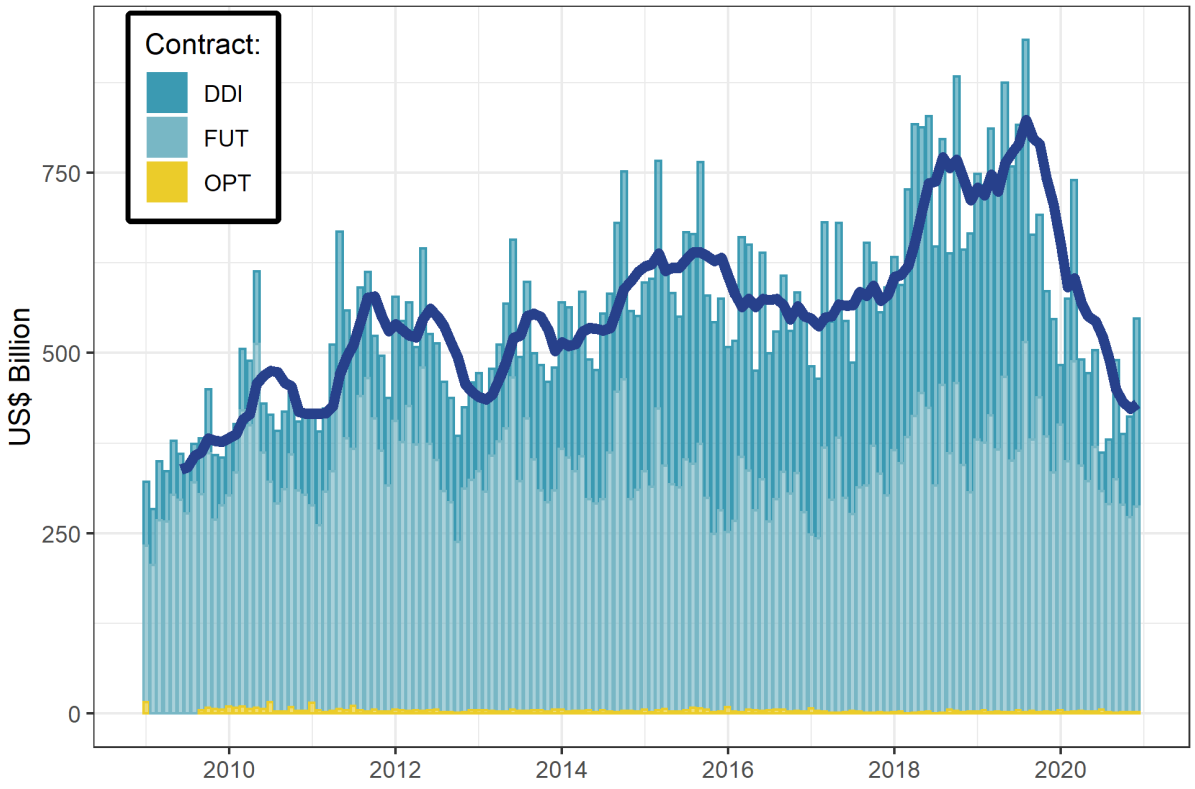
*** p <0.01; ** p <0.05; * p <0.1

Note: Robust standard errors in parenthesis.

Authors' elaboration.

It is interesting to note that, in net terms, non-resident investors were the main final counterpart of the BCB's swaps in the derivatives markets – as can be seen in Figure 4.2. This finding indicates that the BCB offered a bridge that non-resident investors took to avoid the consequences of the significant depreciation of the BRL in the period. For Barroso (2019), these policies were crucial to avoid a financial crisis like the 1990s and early 2000s.

Figure 4.3: Monthly financial volume of foreign exchange derivatives at the B3, 2009-2020



Note: the line represents a 6 months moving-average of the total financial volume.
Source: B3.
Author's elaboration.

We conclude this subsection by presenting the volume traded at the FX derivatives markets at the B3 between 2009 and 2020 in Figure 4.3. As can be seen, the volume increased steadily between 2013 and 2019, when the BCB was active in the DNDFs markets. This period witnessed different turbulent periods in the Brazilian FX markets, but the volume traded did not shrink as usually happens when expectations are firmly held in one direction (Farhi, 2001). This finding further reinforces that the DNDFs facilitated hedging activity in these markets. On the other hand, the volume in the second half of 2019 and throughout 2020 was markedly lower than in the previous years, as was the DNDFs' interventions of the BCB in the period.[9] Although it is early to draw strong conclusions about the ramifications of the Covid-19 crisis and the BCB's policy during Bolsonaro's

[9]In the second half of 2019, the BCB removed DNDFs from the market at the same time as it sold international reserves, with the objective of reducing the total level of international reserves while keeping the level of reserves net of DNDFs stable. The monetary compensation of these sales of international reserves led to a reduction in the interest-bearing liabilities of the consolidated public sector, raising the suspicion that the BCB was acting to reduce the total government debt, a policy objective of the federal government. The Covid-19 crisis put an end to this policy. An in-depth analysis of the exchange rate policies during the Campos Neto presidency in the BCB remains as an avenue for future research.

administration, this finding suggests that the volume in Brazilian FX derivatives markets – especially in the DDI market – depends on BCB's DNDFs.

4.3.2.2 Taming excessive volatility

In subsection 4.3.1.3, we argued that one of the reasons behind DNDFs' interventions was to offset excessive BRL volatility. Our goal in this subsection is to provide some clues about whether the BCB could do so in the 2010s. However, this is not an easy task. The problem is that interventions aimed at reducing excessive volatility usually lean against the wind in the foreign exchange markets. For example, if the central bank decided to intervene after seeing the exchange rate depreciate by 5% in a single day and the exchange rate depreciated 1% at the end of the day due to the intervention, this intervention should be considered successful. However, if all interventions had these characteristics, an econometric analysis would capture a negative relationship between the central bank's interventions and the exchange rate variation. This is a classical endogeneity problem (Chamon et al., 2019a).

One way to tackle this problem is to undertake event-like studies that isolates the intervention and analyses the markets before and after them. This strategy is common in high-frequency studies (e.g., Kohlscheen and Andrade (2014)). However, when the central bank claims that it will do whatever it takes to reduce the volatility in the markets, it is clearly looking to developments at a daily and weekly level.

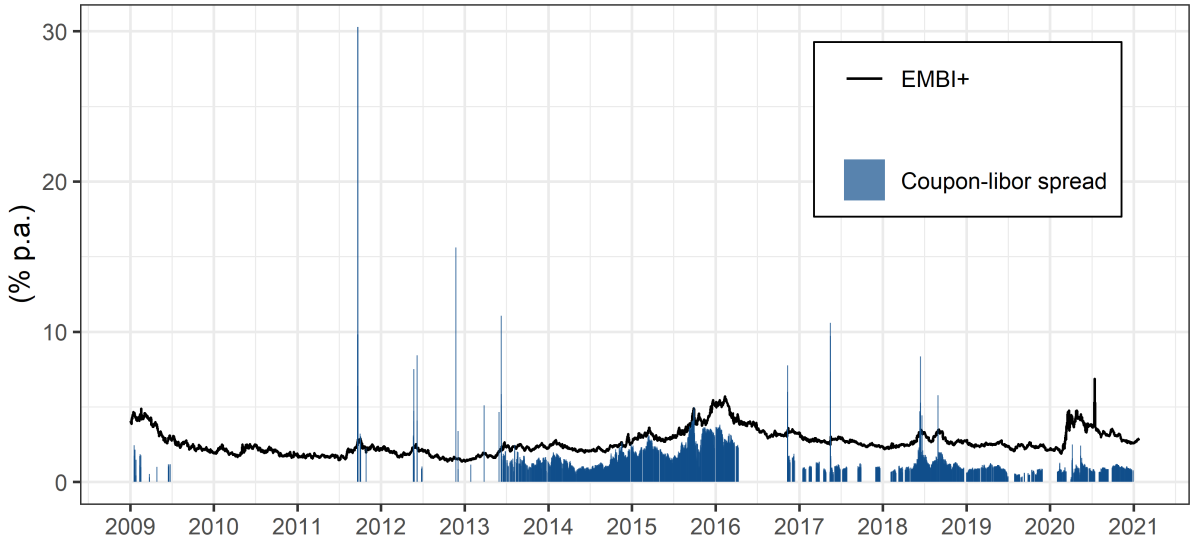
On the other hand, most of the DNDF' interventions wanted to strengthen the hedging markets with a minimal impact on the exchange rates (Barroso, 2019). Only occasionally the BCB intervened to offset excessive currency volatility. Therefore, instead of looking at all BCB's interventions, we focus on a subset of interventions that appears to be aimed at taming excessive volatility. This strategy allows us to undertake an event-like study at the daily frequency.

The crucial task here is to identify this subset of interventions. Given the transmission mechanism discussed in section 4.3.1.4, it is reasonable to expect that interventions aimed at reducing excessive volatility would offer higher-than-usual coupons (HC) – i.e., a lower implicit exchange rate – to maximize their impact on the exchange rates.

To identify interventions with higher-than-usual coupons, we take advantage of the fact that coupon rates are supposed to reflect the libor plus a country-risk premium (Rossi, 2016). Therefore, the spread between coupon rates and the libor of the same maturity should be similar to country-risk premium measures. The monthly 'open market' reports of the BCB between 2009 and 2020 provided information about the coupon associated with each intervention. Next, we looked at the JP Morgan Emerging Market Bond Index Brazil (EMBI+) to have a measure of the Brazilian country risk-premium.

The comparison between the coupon-libor spreads[10] and the EMBI+ is displayed in Figure 4.4.[11] The height of the bars indicates the spread between the coupon rates offered with these contracts and the libor, while the black line shows the EMBI+. As can be seen, only a small fraction of DNDFs offered a coupon-libor spread that exceeded the EMBI+ threshold, and when they did, it was usually by a large amount. Therefore, we classified the DNDFs that offered coupon-libor spreads above the EMBI+ as HC interventions.

Figure 4.4: Coupon-libor spread against EMBI+, 2009-2020



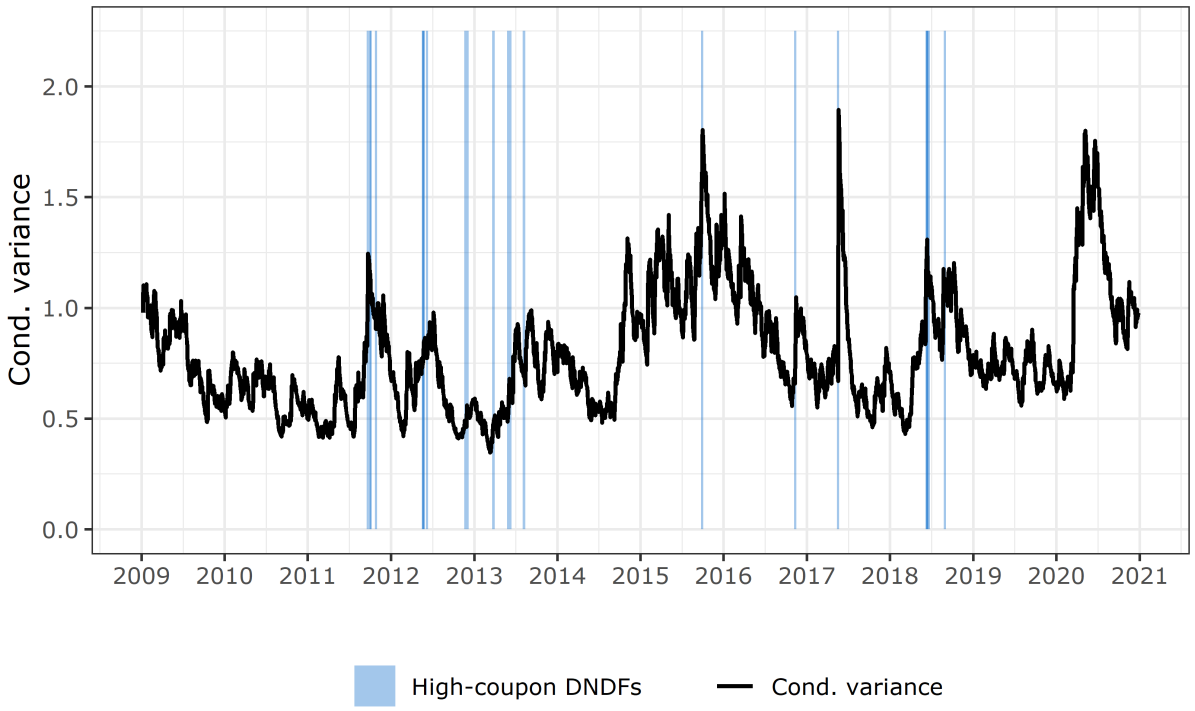
Source: BCB (coupon rate); St. Louis Federal Reserves (libor rates); Ipeadata (EMBI+). Author's elaboration.

The second step is to check whether these HC interventions matched periods of higher BRL volatility. To do so, we estimated the conditional variance of the PTAX exchange rate with an EGARCH model – a common measure of currency volatility – to see if HC DNDFs were auctioned in periods of high BRL volatility. As can be seen in Figure 4.5, the BCB auctioned most of these DNDFs close to local volatility clusters. Figure 5 also reveals the absence of HC interventions during the first wave of the Covid-19 crisis, despite the huge volatility spike registered in the first half of 2020.

[10]To calculate the spread between the coupon and the libor rate, we used the maturity of every lot as declared in the announcement. Since data for the libor is only available at 2 weeks, 1, 2, 3, 6 and 12 months, we utilized the closest lower maturity as a comparison.

[11]We removed the few observations with negative coupon rates. Negative coupon rates may arise with unexpected interventions at the end of the trading day when the PTAX rate was already defined, and the future rate moved upwards.

Figure 4.5: PTAX volatility and high-coupon interventions, 2009-2020



Author's elaboration.

Therefore, HC interventions appear to be good candidates to evaluate whether the BCB could tame excessive currency volatility, and we focus on the evolution of the foreign exchange markets around them to assess the "offsetting excessive volatility" objective of the BCB with its DNDFs.

There were 22 such interventions, but a couple of them took place on subsequent days. Therefore, we grouped the HC interventions into 'windows' of interventions that do not overlap with each other. In this way, we can undertake an event-like strategy that clearly separate the periods before and after the interventions. Fratzscher et al. (2019) employ a similar approach to analyse the effectiveness of a panel of central bank's FX interventions in limiting the volatility of their currencies by comparing the variation of the exchange rate before and after the interventions.

Our analysis consists of testing whether there is evidence of a premium in the PTAX – the official BRL/USD exchange rate – market after controlling for global indicators before the windows (thus igniting the interventions), and whether this premium (if it exists) subsided after the interventions. To econometrically investigate these relations, we collected the daily (log) variations of the dependent (PTAX) and independent variables (the VIX, oil prices, and the average variation of other DEEs' currencies) up to ten days before and after each window. We then created ten datasets, each adding one day to the average variation of the variables, starting from the day immediately before/after the intervention, and finishing with the average variation of the selected variables ten

days before/after each window. We included a dummy that takes the value of 1 if the observation happened before the window and 0 otherwise ("before"). All the variables were normalized by their standard deviations. The estimated models have the following format:

$$\frac{\Sigma_1^{days}\Delta PTAX_i}{days} = Int. + \gamma before_i + \beta_1 \frac{\Sigma_1^{days}\Delta FXdees_i}{days} + \beta_2 \frac{\Sigma_1^{days}\Delta VIX_i}{days} + \beta_3 \frac{\Sigma_1^{days}\Delta OIL_i}{days} + \epsilon_i \tag{4.2}$$

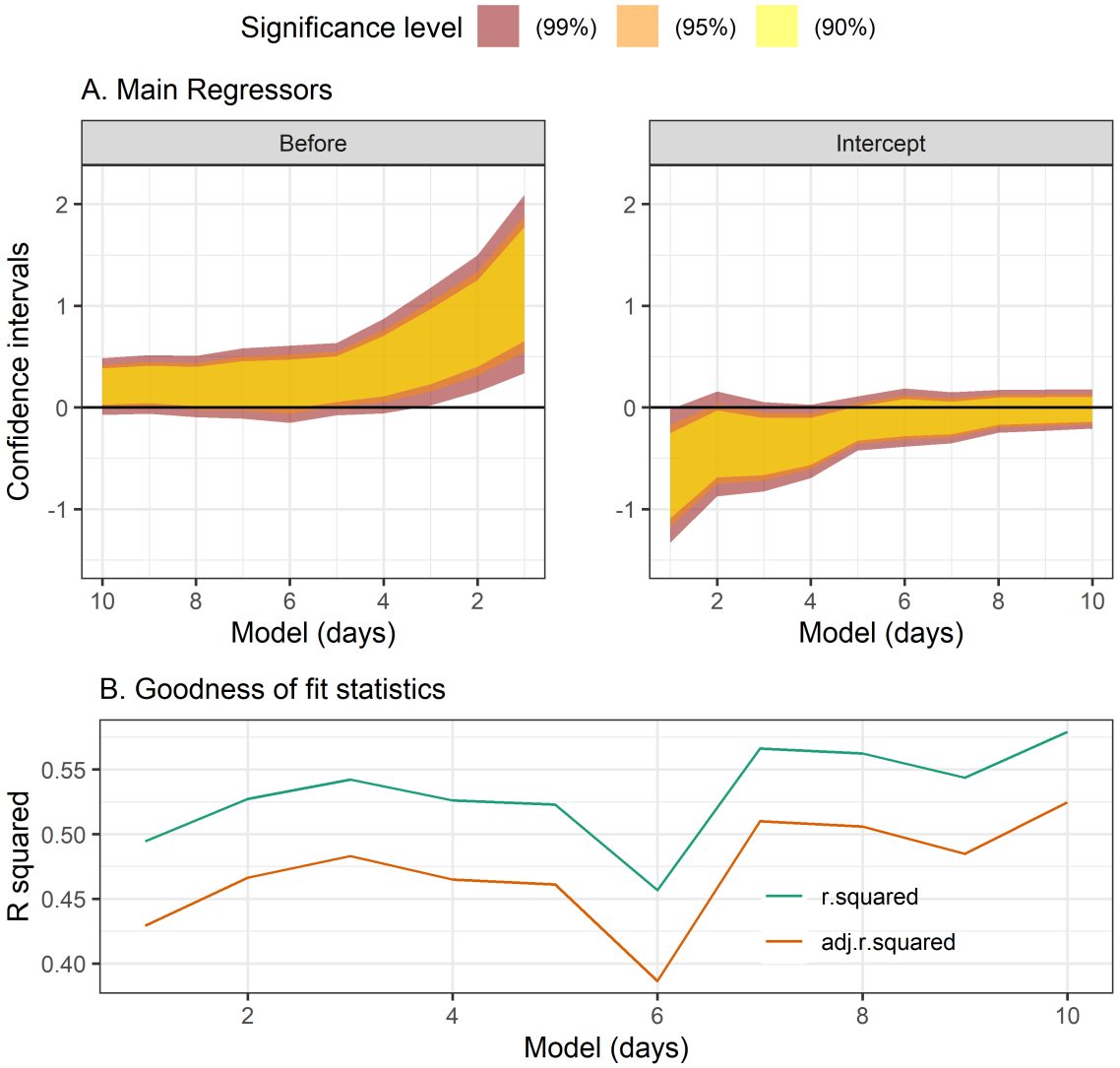
We used the SMDM method proposed by Koller and Stahel (2011, 2017) to estimate the models as it generates robust standard errors and estimates in the presence of small samples and outliers. Since there are 18 HC windows, each estimated model has 36 observations. The estimated confidence intervals of the intercept and the before dummy are presented in Figure 6, together with the respective R-squared measures of the models.[12]

As shown in panel A of Figure 4.6, the estimated confidence intervals of the "before" dummy was positive and significant on the models that included the average variation of the variables on the first; first and second; first, second, and third; and up to the fourth day before and after the windows. On the other hand, the confidence intervals of the intercept were mostly negative but not statistically significant. These findings suggest that HC interventions were auctioned in periods in which there was a premium in the PTAX market above the influence of global variables and that this premium statistically disappeared afterward.

To test the robustness of our results, we estimated the conditional mean of the returns of the PTAX as a function of HC interventions and the global covariates with different specifications of GARCH models. We present these results in the appendix 4.B (Table 4.B.1). The coefficients that capture the relationship between HC interventions and the PTAX were significant in every model and consistent with the analysis presented above.

[12]Tables 4.A.1 and 4.A.2 in the appendix 4.A present the estimates of the models.

Figure 4.6: Estimated confidence intervals and R-squared of the windows' regression models



Author's elaboration.

4.3.3 Limitations of DNDFs

So far, we have discussed why the BCB intervened with DNDFs and argued that it was relatively successful in achieving its objectives. It is time to discuss the limitations of this policy. From a technical perspective, the DNDFs can serve as a hedging instrument as long as the economic agents believe that they can convert these derivatives into foreign currencies in the case of necessity. In other words, there is a convertibility risk attached to these instruments. Nonetheless, Barroso (2019) and Garcia and Volpon (2014) emphasize that the significant level of international reserves held at the Brazilian Central Bank has virtually eliminated this risk in the 2010s (see also column "e" of Table 4.2).

There are three other drawbacks associated with the utilization of DNDFs. Their utilization can result in significant financial losses at the central bank, which may harm

its reputation and the credibility of its policies. Moreover, these losses have a procyclical monetary impact, expanding the interest-bearing liabilities of the central bank. Finally, there is a moral hazard problem associated with the interventions since the frequent utilization of DNDFs may end up stimulating speculative activities and risk-taking behaviour in the economy.

4.3.3.1 Financial losses

The central bank may incur significant financial losses with its DNDFs if the exchange rate moves against its position. These losses increase the nominal deficit of the public sector and can harm the credibility of policymakers. In 2015, for example, the BCB spent 102 billion BRL – the equivalent of 1.7% of the Brazilian GDP – to cover its losses with DNDFs (see column "b" of Table 4.2), which fuelled the criticism over Rousseff's government policies (Bacha, 2016). However, these losses must be seen in the broader context of preserving the financial stability mandate of the BCB. If they help to prevent a financial crisis, then they should be judged with the avoided crisis in sight. Furthermore, these are losses in BRL, allowing much more monetary autonomy to the BCB to intervene than if it had to use its limited foreign assets.

It is important to analyse these losses in the context of all BCB's foreign exchange operations. The profits and losses with DNDFs depend on the variation of the BRL/USD exchange rate, which also determines the capital gains of the BCB with respect to its international reserves. Since these results vary in opposite directions (a depreciation of the BRL leads to losses with DNDFs and capital gains with respect to the international reserves), the DNDFs of the BCB are hedged by its foreign exchange reserves – as long as the notional exposition of the BCB with these derivatives remains smaller than its international reserves.

Table 4.2: Foreign exchange results of the Brazilian Central Bank, 2009 – 2020. BRL or USD Million (% of GDP).

	DNDFs[1]		International reserves		Net international reserves	BRL/USD exchange rate variation[5]	Total FX results
	Notional exposition[2]	Competence result	Total[3]	Net profits[4]			
	(USD)	(BRL)	(USD)	(BRL)	(USD)	(%)	(BRL)
Year	a	b	c	d	$e = c + a$	f	$g = b + d$
2009	0	2,281	238,520	-150,000	238,520	-25.5	-147,719
	(0)	(0.07)	(12.46)	(-4.5)	(12.46)		(-4.43)
2010	0	0	288,575	-48,530	288,575	-4.3	-48,530
	(0)	(0)	(12.37)	(-1.25)	(12.37)		(-1.25)
2011	857	694	352,012	43,346	352,869	12.6	44,041
	(0.04)	(0.02)	(15.09)	(0.99)	(15.12)		(1.01)
2012	-1,007	1,124	373,147	21,185	372,140	8.9	22,309
	(-0.04)	(0.02)	(15.84)	(0.44)	(15.79)		(0.46)
2013	-31,966	-2,382	358,808	34,068	326,842	14.6	31,685
	(-1.4)	(-0.04)	(15.77)	(0.64)	(14.36)		(0.59)
2014	-107,281	-10,681	363,551	24,630	256,270	13.4	13,950
	(-4.93)	(-0.18)	(16.71)	(0.43)	(11.78)		(0.24)
2015	-109,294	-102,628	356,464	259,973	247,170	47.0	157,345
	(-7.12)	(-1.71)	(23.21)	(4.34)	(16.1)		(2.62)
2016	-26,236	83,804	365,016	-324,123	338,780	-16.5	-240,319
	(-1.36)	(1.34)	(18.98)	(-5.17)	(17.61)		(-3.83)
2017	-23,680	6,283	373,972	-52,705	350,292	1.5	-46,422
	(-1.19)	(0.1)	(18.79)	(-0.8)	(17.6)		(-0.7)
2018	-67,080	-14,260	374,715	141,328	307,635	17.1	127,068
	(-3.71)	(-0.2)	(20.73)	(2.02)	(17.02)		(1.81)
2019	-34,921	-7,744	356,884	42,826	321,963	4.0	35,082
	(-1.9)	(-0.1)	(19.42)	(0.58)	(17.52)		(0.47)
2020*	-58,210	-40,986	355,620	448,628	297,410	28.9	407,642
	(-4.08)	(-0.55)	(24.94)	(6.05)	(20.86)		(5.5)

Sources: BCB - Demonstrações financeiras; Notas para imprensa - Política fiscal; SGS.
Notes:
*/ Preliminary data.
1/ Operations realized through auctions and registered at the B3.
2/ Notional value of the BCB exposition with DNDFs. Short-USD positions are registered with negative values.
3/ International reserves - Liquidity concept. SGS code: 3546.
4/ Capital gains plus interest income minus international reserves' carrying costs.
5/ Free purchase BRL/USD exchange rate, end of period. Variation from December to December. SGS code: 1.
Authors' elaboration.

As can be seen in the column "g" of Table 4.2, the capital gains of the BCB with its international reserves comfortably covered DNDFs' losses (column "b"), even at the peak of the "daily feeding" program in 2015, when the notional exposition with these derivatives reached the equivalent of 7.1% of the Brazilian GDP (column "a" of Table 4.2). In this year, the BCB recorded a profit equivalent to 2.6% of the Brazilian GDP. Macalós (2020) argues that this type of accounting hedging where unrealized capital gains cover the central bank's losses increases the policy space of DEEs' central banks to adopt

countercyclical foreign exchange policies. These dynamics further emphasize that DNDFs are more effective when the central bank holds significant stocks of international reserves to back them up.

There is a caveat to this point: financial losses with DNDFs are spent into the economy, generating monetary side effects, while capital gains are unrealized and affect only the balance sheet of the central bank. It is to the consequences of this caveat that we turn next.

4.3.3.2 Procyclical monetary implications

According to the BCB's website, one advantage of DNDFs is that they do not affect the economy's money supply. However, this point is only partially correct. Since the auction of a DNDF contract does not trigger an immediate financial transaction, it does not require any immediate compensatory measure by the BCB. Nonetheless, financial losses with them trigger a transfer of resources from the central bank to its counterparties. As a consequence, these losses circulate in the interbank market and oblige the central bank to intervene to sustain its base interest rate target. Barbosa et al. (2019), for example, discuss how the losses with DNDFs led to an increase in the liquidity absorbing operations by the BCB in the 2010s.

Table 4.3 illustrates how DNDF losses affect the overall liquidity in the bank reserves' market and the balance sheets of the central bank and the counterparty bank in the instrument. The operation starts with the central bank making losses with DNDFs and crediting the bank's reserve account to pay for it (row 1). This operation is registered as a loss in the central bank accounts and drains its capital. On the other hand, the bank registers a profit in its accounts and sees its assets increase in the form of higher bank reserves at the central bank. Since banks do not wait for new money to grant new loans, they try to eliminate these new bank reserves, pressuring down the interbank interest rate (Lavoie, 2014).To keep the interest rate on target, the central bank must intervene to compensate for this effect. It does so by draining the newly created bank reserves by issuing reserve repos, remunerated at the base interest rate (row 2).[13] At the end (row F), the central bank's losses with DNDFs reduced its capital and increased its interest-bearing liabilities. The size of its balance sheet remained constant. From the side of banks, their profits with DNDFs lead to higher reverse repos in their assets and higher equity. Their balance sheets increase.

It is important to emphasize that Table 4.3 analyses DNDFs' losses in isolation, abstracting away the accounting coverage of these losses by the capital gains made with the international reserves. However, it is instructive for showing that even when covered

[13]The result would be the same regardless of the monetary policy operation.

by these capital gains, DNDFs' losses are realized into the economy and increase the outstanding number of governments' interest-bearing liabilities in the market.

Table 4.3: Balance sheet consequences of central bank's losses with DNDFs.

	Central Bank		Bank	
	Assets	Liabilities	Assets	Liabilities
(1)		(DNDFs' losses) - 100 Bank reserves + 100	Bank reserves + 100	(Profits with DNDFs.) + 100
(2)		Reverse repos + 100 Bank reserves - 100	Reverse repos + 100 Bank reserves - 100	
(F)		(DNDFs' losses) - 100 Reverse repos + 100	Reverse repos + 100	(Profits with DNDFs.) + 100

Author's elaboration.

As we argued earlier in the paper, the BCB sees the DNDFs as a useful alternative to selling foreign exchange reserves because they can accommodate the markets' demand for hedging without reducing its foreign assets. It is time to see how the direct supply of foreign currency would affect the markets to grasp the trade-offs involved in utilizing these derivatives.

The consequences of the sales of international reserves on the interbank market are illustrated in Table 4.4. Row (1) presents the sale of international reserves by the central bank. As banks pay for these foreign assets using their reserves at the central bank, the composition of their assets changes, with foreign currency replacing their reserves. On the balance sheet of the central bank, a reduction in its assets (international reserves) is matched by a reduction in its liabilities (bank's reserves). However, the reduction of the bank's reserves at the central bank creates an imbalance in its balance sheet. In our example, the commercial bank restores the balance in its balance sheet by selling some of its reverse repos back to the central bank (row 2). By the end of the operation (row F), the central bank's balance sheet decreases. The reduction of its assets is matched by a reduction of its interest-bearing liabilities. On the other hand, the balance sheet of the commercial bank remained constant in size but with foreign currency instead of domestic interest-bearing liabilities.

Table 4.4: Balance sheet consequences of sales of international reserves

	Central Bank		Bank	
	Assets	Liabilities	Assets	Liabilities
(1)	USD reserves - 100	Bank reserves - 100	USD deposits + 100 Bank reserves - 100	
(2)		Reverse repos - 100 Bank reserves + 100	Reverse repos - 100 Bank reserves + 100	
(F)	USD reserves -100	Reverse repos - 100	USD deposits +100 Reverse repos -100	

Author's elaboration.

Therefore, the choice between DNDFs or international reserves is not neutral from a distributive perspective. The compensation of the liquidity created by DNDFs' losses leads to an increase in the interest-bearing liabilities of the central bank. In contrast, the sale of international reserves leads to a decrease in these liabilities. There is an unavoidable trade-off in the decision to use DNDFs instead of selling foreign exchange reserves.

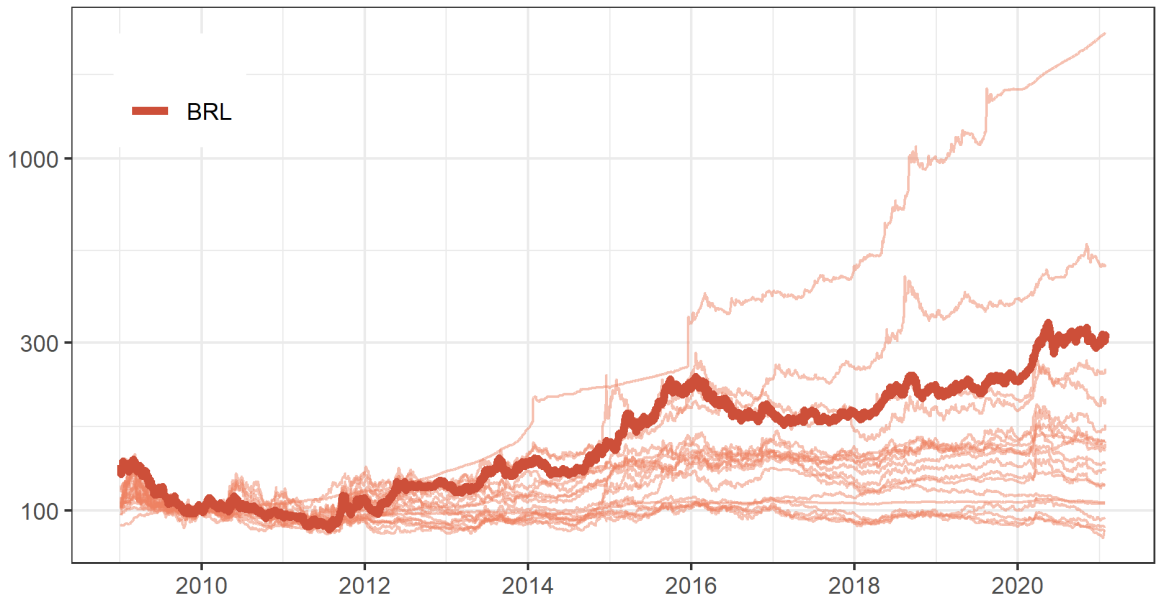
4.3.3.3 Financial feast: the moral hazard problem revisited

Another limitation of foreign exchange rate policies is that they can create moral hazard problems. Like lender of last resort policies, the knowledge that the central bank is ready to intervene to support the markets can induce economic agents to engage in riskier behaviour. Barroso (2019) and Chamon and Magud (2019) underline the possibility that domestic agents would engage in riskier borrowing in foreign currencies given the readiness of the BCB to intervene with DNDFs.

Musthaq (2020) highlights a different face of this problem. For her, the flip-side of the expansion of non-resident investments in assets denominated in DEEs' currencies is the implicit insurance given by emerging markets' central banks to provide liquidity in the foreign exchange markets. She argues that the accommodative stance of DEEs' central banks was crucial to attract funds from global investors to assets denominated in peripheral currencies. According to her, central banks provide foreign exchange liquidity by intervening in the spot FX markets and insurance against exchange rate fluctuations by offering derivatives contracts. Therefore, DEEs central banks increase the attractiveness of their assets by assuming a substantial part of the risks incurred by international investors and speculators, creating a financial feast for global investors in search of high-yielding assets. As a consequence, central bank interventions might be self-defeating since they might end up increasing the volatility of these markets by facilitating the movements of global portfolio investors in and out of these markets.

The Brazilian experience in the 2010s is consistent with these claims. At the same time as non-resident increased their appetite for locally denominated assets (Souza Rosa and Biancareli, 2016), the Brazilian FX derivatives markets were known to attract speculative investments from non-residents (Prates and Farhi, 2015; Rossi, 2016). During this period, the BRL was quite volatile when compared to its DEEs' peers and linked with the global financial cycle (Kaltenbrunner, 2015a), even though the BCB was not shy to intervene in the FX markets. As shown in Figure 4.7, the BRL was one of the DEEs currencies that mostly appreciated until 2011 and then one of the currencies that mostly depreciated from 2012 to 2020.

Figure 4.7: Evolution of DEEs' exchange rates with the USD, 2009-2020



2010 = 100. The DEEs included are Colombia, Argentina, Czechia, Hungary, Indonesia, Israel, India, Korea, Kuwait, Mexico, Malaysia, Philippines, Poland, Romania, Russia, Thailand, Turkey, Taiwan, and South Africa.
Source: BIS.
Author's elaboration.

On the other hand, data from 2020 show that interventions with DNDFs after the first wave of the Covid-19 crisis was more timid than earlier in the decade. During this year, the financial volume traded at the B3 FX derivatives markets was smaller than in previous years (Figure 4.3), even though the overall financial volume in the B3 derivatives markets was at its peak in 2020,[14] suggesting that part of the attractiveness of Brazilian FX derivatives markets' is linked to BCB's interventions.

These problems illustrate that DNDFs are not a panacea. They are a good policy to limit the damage caused by the swings of the global financial cycle, but they are

[14] http://www.b3.com.br/en_us/market-data-and-indices/data-services/market-data/reports/derivatives-market/summary-of-operations/estatisticas/

not capable of insulating these economies from these swings. As De Conti et al. (2014) argue, climbing the currency hierarchy is a long-term process that cannot be achieved by liberalizing the foreign exchange markets alone. Our analysis suggests that adding DNDFs interventions to the mix does not provide a ladder to climb this hierarchy. That is why we agree with Prates and Fritz (2013), Prates and Farhi (2015), and Rossi (2016) when they argue that foreign exchange interventions must be accompanied by tighter regulation of the foreign exchange derivatives markets and prudential capital controls.

4.4 Final remarks

The Brazilian experience shows that interventions with DNDFs are a useful addition to a DEEs' central banks' toolkit to deal with capital flights and currency depreciation. We analysed official documents and communications with the press to show that the BCB pursued two objectives with its DNDFs: strengthening hedging markets and offsetting excessive volatility. We then evaluated the effectiveness of these interventions empirically.

First, we provided evidence of the liquidity provision role of the DNDFs by comparing the net open positions of commercial banks and institutional investors in the spot and the derivatives markets with their open positions with DNDFs. These data suggest that market makers hedged their sales of USD-linked derivatives and spot USD with DNDFs.

Secondly, we analysed how the central bank intervened sporadically to tame excessive volatility in BRL markets. We first noted that a subset of the DNDFs' interventions that took place during local volatility clusters offered higher-than-usual coupons. We analysed the market developments around these interventions and presented evidence that suggests that the BCB was able to tackle the excessive volatility of the BRL with these interventions.

It is essential to bear in mind that the financial outcomes of the DNDFs are settled in BRL. This characteristic granted much more leeway to the BCB to deal with the costs of these interventions. Nonetheless, the financial losses with these instruments undermined the credibility of the BCB's foreign exchange policies – especially at the end of Rousseff's government – and led to their dismantling in 2015. Furthermore, these losses increased the interest-bearing liabilities of the central bank, constraining the internal policy space of the monetary authority.

Our assessment of the Brazilian DNDFs policy is that having these instruments at hand is beneficial for DEEs' central banks. They bypass the intrinsic constraint faced by DEEs' authorities when they need to increase the supply of foreign currencies: their scarcity. Saving reserves is also beneficial for financial stability, as falling reserves can be perceived as a sign of weakness, triggering attacks against the currency. Furthermore, the DNDFs benefit from the leverage provided by derivatives markets to raise the bar against speculators. However, they are not a panacea, and DEEs should consider their adoption

together with other prudential policies to maximize their defence against the instability of globalized financial markets.

Appendix

4.A Windows' estimations

Table 4.A.1: Windows' models. Model "1 day" to model "5 days."

	1 days	2 days	3 days	4 days	5 days
(Intercept)	-0.6731^{**}	-0.3581^{*}	-0.3854^{**}	-0.3338^{**}	-0.1575
	(0.2547)	(0.2006)	(0.1707)	(0.1400)	(0.1033)
groupbefore	1.2155^{***}	0.8260^{***}	0.5989^{**}	0.4065^{**}	0.2781^{*}
	(0.3420)	(0.2604)	(0.2252)	(0.1804)	(0.1377)
vix_mean	0.1244	0.1390	0.0727	0.2653	0.2327
	(0.1374)	(0.1406)	(0.1989)	(0.1790)	(0.1612)
oil_mean	-0.2870	-0.3079	-0.2159	0.0687	-0.1010
	(0.2782)	(0.2804)	(0.2457)	(0.2230)	(0.1968)
dees_mean	0.3430^{*}	0.4693^{***}	0.6140^{***}	0.5934^{***}	0.4813^{***}
	(0.1863)	(0.1543)	(0.1653)	(0.1541)	(0.1325)
Num. obs.	36	36	36	36	36

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Robust SMDM standard errors in parentheses.

Authors' calculations.

Table 4.A.2: Windows' models. Model "6 days" to model "10 days."

	6 days	7 days	8 days	9 days	10 days
(Intercept)	−0.0995	−0.1029	−0.0371	−0.0265	−0.0168
	(0.1109)	(0.0977)	(0.0817)	(0.0786)	(0.0746)
groupbefore	0.2286	0.2352*	0.2060*	0.2272*	0.2048*
	(0.1477)	(0.1343)	(0.1173)	(0.1120)	(0.1082)
vix_mean	0.1700	0.1753	0.3163	0.4469*	0.3451
	(0.1924)	(0.2121)	(0.2037)	(0.2478)	(0.2631)
oil_mean	−0.0788	0.0469	−0.0028	−0.0759	0.0241
	(0.2255)	(0.2024)	(0.1858)	(0.1829)	(0.1980)
dees_mean	0.5705***	0.6461***	0.5608***	0.5016***	0.5504***
	(0.1795)	(0.1686)	(0.1664)	(0.1722)	(0.1731)
Num. obs.	36	36	36	36	36

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Robust SMDM standard errors in parentheses.

Authors' calculations.

4.B Robustness check: GARCH estimations

To test the robustness of our results, we estimated the conditional mean of the returns of the PTAX as a function of HC interventions and the three global covariates used in the "windows" estimations with different specifications of GARCH models. The HC intervention dummy was included with a lag to avoid simultaneity issues. We also included a lead HC intervention dummy to flag whether there were some abnormal movements before the interventions. As in the "windows" models, we normalized the variables by their standard deviations before the estimations.

The estimated conditional mean equations can be written as:

$$\Delta ln(PTAX_t) = \mu + \Delta ln(oil_t) + \Delta ln(vix_t) + \Delta ln(fx.dees_t) + HC_{t-1} + HC_{t+1} + u_t \quad (4.3)$$

To increase the robustness of our results to different functional forms of GARCH models, we used three specifications to estimate the conditional variance of the PTAX returns: a standard GARCH, a GJR-GARCH, and an EGARCH[15]. We estimated the models under three different assumed theoretical distributions of the residuals: normal, Student, and skewed Student. We discarded the models that assumed a normal distribution due to poor

[15]See Ghalanos (2019) for a detailed explanation of the conditional variance equations.

goodness-of-fit statistics based on the adjusted Pearson Test (available on the code file). Weighted Ljung-Box tests on the standardized residuals show no evidence of remaining autocorrelation in the models. Further, weighted Ljung-Box tests and weighted Arch-LM tests on the squared standardized residuals show no signs of remaining heteroskedasticity in the model. The significance of the *shape* and *skew* coefficients further indicates the non-normality of the residuals. These tests are available in the code file annexed to this paper. Finally, robust standard errors were used to compute the p-values. We present the estimations in Table 4.B.1:

Table 4.B.1: Robustness check: GARCH estimations

	sGARCHstd	eGARCHstd	gjrGARCHstd	sGARCHsstd	eGARCHsstd	gjrGARCHsstd
			Conditional mean			
mu	0.011	0.018 *	0.017	0.017	0.024	0.022
	[-0.013; 0.035]	[0.007; 0.029]	[-0.008; 0.041]	[-0.009; 0.042]	[-0.002; 0.051]	[-0.003; 0.047]
vix	0.072 *	0.068 *	0.071 *	0.072 *	0.069 *	0.072 *
	[0.047; 0.097]	[0.046; 0.090]	[0.046; 0.097]	[0.048; 0.097]	[0.042; 0.096]	[0.047; 0.097]
oil	-0.135 *	-0.138 *	-0.135 *	-0.136 *	-0.140 *	-0.137 *
	[-0.180; -0.090]	[-0.175; -0.102]	[-0.181; -0.090]	[-0.181; -0.092]	[-0.193; -0.087]	[-0.181; -0.092]
fx_dees	0.391 *	0.390 *	0.391 *	0.389 *	0.388 *	0.389 *
	[0.343; 0.440]	[0.347; 0.434]	[0.344; 0.438]	[0.340; 0.438]	[0.342; 0.435]	[0.341; 0.436]
hc_lag	-0.530 *	-0.532 *	-0.529 *	-0.536 *	-0.538 *	-0.535 *
	[-0.911; -0.148]	[-0.903; -0.161]	[-0.913; -0.146]	[-0.936; -0.136]	[-0.927; -0.148]	[-0.938; -0.131]
hc_lead	0.508 *	0.506 *	0.488 *	0.507 *	0.506 *	0.487 *
	[0.126; 0.891]	[0.187; 0.825]	[0.125; 0.850]	[0.120; 0.894]	[0.181; 0.830]	[0.123; 0.852]
			Conditional variance			
omega	0.010 *	-0.007 *	0.009 *	0.010 *	-0.006 *	0.009 *
	[0.002; 0.018]	[-0.011; -0.003]	[0.000; 0.017]	[0.002; 0.017]	[-0.011; -0.002]	[0.000; 0.017]
alpha1	0.078 *	0.049 *	0.103 *	0.078 *	0.051 *	0.104 *
	[0.041; 0.116]	[0.025; 0.073]	[0.051; 0.155]	[0.041; 0.115]	[0.026; 0.075]	[0.052; 0.156]
beta1	0.909 *	0.990 *	0.913 *	0.910 *	0.990 *	0.914 *
	[0.865; 0.954]	[0.988; 0.991]	[0.864; 0.963]	[0.866; 0.954]	[0.988; 0.991]	[0.865; 0.962]
shape	6.606 *	6.968 *	6.816 *	6.620 *	6.984 *	6.830 *
	[4.813; 8.399]	[4.905; 9.030]	[4.837; 8.794]	[4.829; 8.411]	[4.909; 9.059]	[4.858; 8.802]
gamma1		0.123 *	-0.053 *		0.123 *	-0.055 *
		[0.082; 0.164]	[-0.096; -0.010]		[0.082; 0.164]	[-0.098; -0.011]
skew				1.039 *	1.050 *	1.043 *
				[0.976; 1.101]	[0.987; 1.114]	[0.981; 1.105]
R^2	0.280	0.279	0.280	0.280	0.279	0.279
Adjusted R^2	0.279	0.278	0.279	0.278	0.278	0.278
AIC	2.251	2.242	2.248	2.251	2.242	2.248
BIC	2.272	2.266	2.272	2.274	2.268	2.274
Log Likelihood	-3093.608	-3081.354	-3088.956	-3092.688	-3079.816	-3087.804
Num. obs.	2758	2758	2758	2758	2758	2758

* Null hypothesis value outside the 95% confidence interval.

As shown in the upper part of the Table 4.B.1, the dummies that capture the relationship between HC interventions and the variation of the PTAX were significant in every model, with sizeable estimates. The coefficients have the expected sign, i.e., that, everything else constant, the variation of the PTAX was expected to be negative in the days following the HC interventions, and positive in the days immediately before the interventions. The estimated parameters of the conditional variance equations are shown in the lower part of the Table 4.B.1.

Chapter 5

Accounting for foreign exchange operations and its implications for monetary policy implementation: international experience and the case of Brazil[1]

Abstract: This paper analyzes how the accounting framework can affect the operational capacity of the central bank. The separation of realized and unrealized results, for instance, can create inflated revaluation buffers next to persistent losses in developing economies. The consolidation and transfer of these results to the government, on the other hand, gives flexibility to intervene in foreign exchange markets but might lead to undesired monetized financing. By analyzing the Brazilian experience, we show that the law 13,820 synthesizes these dilemmas: it provides flexibility to the central bank without allowing the transfer of unrealized gains to the government. Yet, a simulation of the Brazilian Central Bank's (BCB) accounts under this framework reveals that the virtual absence of losses covered by the government would have had the unexpected consequence of preventing the transfer of securities to the BCB when the Brazilian real appreciated, forcing the treasury to replenish the portfolio of the BCB at the height of the 2015-16 crisis.

Keywords: Central bank accounting; monetary policy; foreign exchange policy; reverse repurchase agreements.
JEL codes: E12; E52; E58; H83.

[1]The code to replicate this chapter is available at https://github.com/joaomacalos/bkr_accounting_2020

5.1 Introduction

The[2] last three decades witnessed the deregulation of financial markets and the growing integration of many developing economies to the global markets. However, many of these newly integrated economies (NIEs)[3] experienced a severe economic crisis at the end of the 1990s due to an abrupt reversal of capital flows that wreaked havoc in these economies – particularly in those indebted in foreign currencies. As a response to these developments, many of these NIEs accumulated significant stocks of international reserves in the 2000s to insure themselves against such market reactions. This paper deals with one important but often neglected side effect of these hoardings: the expansion of central banks' balance sheets in these countries.

As we are going to see, this expansion creates two problems to central banks: they require the adoption of compensatory measures to keep the operational interest rate on target, which in turn depends on the availability of instruments at the central bank; and they increase the volatility of the results of the central bank. Given the special nature of central banks, the only technical restriction that can arise is related to the availability of instruments to absorb liquidity from the economy. Nonetheless, persistent losses might impair the reputation of central bankers and affect their credibility to undertake costly monetary policies. These problems place the accounting framework – understood broadly to include also the profit distribution scheme and the loss coverage arrangements (Schwarz et al., 2015) – in the center of the stage. As these authors argue, financial reporting and accounting are crucial because they affect the financial buffers and the overall profitability of the central banks. Through these channels, "accounting can influence the decisions made by central banks, their credibility, and, hence, the successful implementation of monetary policy" (Ibid, p. 5). Therefore, the main objective of the paper is to understand how different accounting frameworks can affect the autonomy of the central bank to implement its policies.

We illustrate these issues with a detailed analysis of the Brazilian experience since 2008. This case is relevant because the accumulation of international reserves and the developments that followed led to two important reforms of the local accounting framework since 2008. The first assured an adequate provision of government securities to the Brazilian Central Bank (BCB) and also solved the issue of the profitability by transfer-

[2]This chapter was published at the Brazilian Keynesian Review (Macalós, 2020) and reproduced here. That is why the "NIEs" and "FX Swaps" terminology are kept.

[3]Economies that meet some criteria of integration to the global markets but do not meet the requirements to be classified as a developed economy are usually classified internationally as "emerging" economies (MSCI, 2019). Yet, we prefer the term newly integrated economies to refer to these economies, emphasizing their integration to the global markets without implicitly arguing that they are emerging to a new status. This definition is indebted to the Latin American structuralist definition of underdevelopment as a specific structural state of many economies today that the developed economies did not necessarily experience in the past (Furtado, 1963).

ring the foreign exchange related results directly to the Brazilian Treasury (BT) without recognizing them in the income statement. Furthermore, the consolidation of the realized with the unrealized results of the foreign exchange operations of the BCB under this framework enhanced its room of maneuver to undertake countercyclical foreign exchange rate policies. However, this framework opened a backdoor possibility of monetized financing of the BT, an issue that was fixed by the second reform in 2019. The main lesson to take from the Brazilian experience is that the accounting framework is not neutral and should, therefore, be tailored to address the specificities of each central bank. The paper is structured in seven sections, together with this introduction. In section 5.2, we review the main reason behind the accumulation of international reserves in NIEs. In sections 5.3, 5.4 and 5.5, we deal with the monetary policy implementation framework in central banks, the role of capital in these institutions and review the main accounting frameworks adopted by them. Section 5.6 analyzes the Brazilian case in details and section 5.7 concludes the paper.

5.2 Precautionary accumulation of reserves

The economic crisis of the 1990s triggered an important debate about the external vulnerability of NIEs economies. Since then, many authors came to recognize the structural asymmetries in the international monetary and financial system. Eichengreen and Hausmann (1999) and Eichengreen et al. (2007), for example, argue that most of the NIEs are unable to borrow internationally in their own currencies – the "original sin" hypothesis. For these authors, the reasons behind this inability are independent of the macroeconomic fundamentals of each economy and in fact related to the imperfections of the global financial markets and the transaction costs involved in a diversified portfolio of currencies. Another line of explanation emphasizes the existence of a currency hierarchy in the global financial markets. According to this interpretation, the centrality of some currencies in the global financial and commercial markets – particular of the U.S. dollar (USD) – entails these currencies with a liquidity premium. The convenience of holding other currencies are measured against the convenience of holding the most important currencies of the system. Therefore, most of the currencies worldwide must pay a bonus to attract foreign investors in the form of higher interest rates (De Conti et al., 2013a; Kaltenbrunner, 2015b; Prates, 2005, 2017). These authors also emphasize that regardless of the interest rate differential, in times of global financial distress international investors would prefer the safety of liquid currencies like the USD and would stop flowing to NIEs. Therefore, the currency hierarchy literature emphasizes the role of the liquidity preference of international investors in the determination of capital flows, providing an explanation about the nature of sudden stops, a fact that had been identified by many authors as very harmful to NIEs – particularly when their governments were indebted in foreign currencies (Calvo,

1998; Eichengreen et al., 2007; Goldstein and Turner, 2004; Reinhart and Calvo, 2000). Another consequence of the lower liquidity premium of the currencies in the periphery is that, in the absence of active exchange rate policies, market forces will tend to make them more volatile than the currencies in the apex of the pyramid.[4]

The recognition of these challenges is behind the overall acceptance of the precautionary demand for reserves in NIEs internationally (Dhar, 2012; IMF, 2011). Fischer (2001b), for example, argued in his opening remarks at the IMF and World Bank joint forum about international reserves in the aftermath of the 1990s turmoil that crisis prevention became the most important motive for accumulating international reserves. This was especially true for NIEs open to international capital flows. Furthermore, he noted that countries with higher reserves did better during the 1990s. For Rodrik (2006), one important consequence of the 1990s crisis was a wide recognition that the sound macroeconomic policies recommended by multilateral institutions were not sufficient to shield these economies from the global turmoil and that these institutions failed to provide an adequate support to NIEs during the 1990s crises. Therefore, the policymakers in these countries concluded that they could only rely on their own foreign currency reserves to bridge eventual external liquidity shortages. The acceleration of the hoarding of international reserves in the 2000s should be understood as a market-friendly strategy adopted by these countries to integrate themselves into the global markets. For Aizenman (2008) and Aizenman and Lee (2007), the accumulation of foreign exchange reserves is like an insurance that allows emerging markets to act as "lender of last resort" in foreign currencies, allowing them to reduce the output costs of sudden stops. The crisis of 2008 vindicated the precautionary demand for reserves in NIEs. The works of Aizenman and Sun (2012) and Bussiere et al. (2013), for instance, present evidence that the countries that had previously accumulated significant amount of international reserves fared better during the 2008 crisis than the countries that did not implement this policy, a perception that was shared by many NIEs policymakers (IEO, 2012).

Nonetheless, the accumulation of reserves resulted in the expansion of the balance sheets of central banks in these economies (Erhart et al., 2013; Filardo and Yetman, 2012). Before analyzing the consequences of this development, we must first understand how central banks implement their policies. This is the objective of section 5.3.

5.3 Keeping the interest rate on target

Nowadays it is widely accepted that central banks' main operational target is the short-term interest rate and not monetary aggregates (Bindseil, 2004), an old claim made by horizontalist post-Keynesian authors (Lavoie, 2014). In a nutshell, modern central banks execute their monetary policy by intervening in the interbank market of reserves to keep

[4]See Prates (2015, Chapter 1) for an extensive discussion of this literature.

the overnight interbank rate around the desired target. Since the demand for and supply of bank reserves is highly interest-rate inelastic, even small shortages of reserves would push the interest rate high up, while small surpluses would push it towards zero. As a consequence, central banks have to behave in a defensive manner, supplying or absorbing the necessary amount of reserves to keep the interest rate around its target. In general, this defensive behavior means the announcement of a corridor of liquidity facilities that determines the interest rates at which it will absorb or supply bank reserves around the desired target (Bindseil, 2004; Lavoie, 2014).

The width of the corridor determines the amount of fluctuation around the target interest-rate that the central bank is willing to accept. However, it might be the case that the monetary system operates within a structural, i.e., a persistent shortage of reserves in the interbank market.[5] In this case, we say the economy is running on an "overdraft" system, as banks are being systematically forced to borrow at the lending facility. This happens in particular when central banks do not purchase or hold government bonds. On the other hand, when the monetary authorities, on a regular basis, do hold securities issued by the government, we say that the economy is running on an "asset-based" system since the central bank is either absorbing or providing liquidity in the interbank market by selling or purchasing government securities (or doing so through repos and reverse repos). Banks do not need to take advances from the central bank when they need additional bank reserves. In such asset-based systems, the easiest way to achieve the operational target is to provide an excess amount of reserves (as happens with quantitative easing policies) and to set the return on reserves equal to the target interest rate (Lavoie, 2014).

According to Macedo e Silva (2016), the main variations in the banks' demand for reserves are explained by changes in the autonomous factors, i.e., assets or liabilities in the central bank balance sheet[6] that fluctuate independently of liquidity management operations. Among these autonomous factors, one is highly relevant for this paper: the management of foreign exchange reserves. Whenever a central bank purchases international reserves in the foreign exchange market, it is also injecting bank reserves in the system, which would, ceteris paribus, drive interest rates down in the interbank market. If this central bank wants to sustain its monetary policy target, the acquisition of foreign exchange reserves must be compensated by some other change in the central bank balance sheet. If the economy is in an overdraft system, the banks will themselves decide to use their reserves at the central bank to reduce the advances that they had taken in the past from the central bank and the compensation will require no central bank intervention.

[5]Banks may need central bank money and reserves to fulfill their minimum reserve requirements, to provide cash to its customers and to settle payments in the interbank market (Nagel, 2012).

[6]Commercial banks can individually become more or less liquid but they cannot, as a whole, change the liquidity of the interbank market, since the increase of one bank's assets is matched by another bank's increased liabilities. Therefore, only transactions with an "outside" agent – the central bank in this case – can affect the liquidity of this market (Lavoie, 2014). This fact was already outlined by Keynes (1971).

The central bank may also decide to move government deposits from commercial banks to the central bank, thus also removing the excess bank reserves from the market without offering any interest-rate earning liability to the markets. However, the steady growth of foreign assets in the balance sheet of the central bank will exhaust, at some point, these two compensation mechanisms, and from then on central banks must actively intervene to maintain their operational interest-rate target. The latter type of compensation is commonly known as "sterilization" and can be implemented in many ways. It is important to emphasize that, from this point onwards, we will assume an economy running in an asset-based system, as they are the norm in countries that accumulated significant international reserves. In this situation, "sterilization is not a matter of choice; it is a necessity as long as the central bank wants to keep the interest rate at its target level" (Lavoie, 2014, p. 468). The most common ways that a central bank can compensate the accumulation of international reserves is by selling government securities from its own portfolio – known as open market operations –; by selling these securities within a repurchase agreement – known shortly as reverse repos –; by offering remunerated deposits' facilities at the central bank and also by the issue of central bank bonds. The case of compensation through open-market operations is summarized in Table 5.1:

Table 5.1: Compensation of the acquisition of international reserves through open-market operations.

	Central Bank		Commercial Bank	
	Assets	Liabilities	Assets	Liabilities
(1)	Foreign assets +	Bank reserves +	Foreign assets − Reserves at the central bank +	
(2)	Govt. securities −	Bank reserves −	Reserves at the central bank − Govt. securities +	
(F)	Foreign assets + Govt. securities −		Foreign assets − Govt. securities +	

Author's elaboration.

Table 5.1 breaks down the different steps involved in the acquisition of international reserves by a central bank in an asset-based system. The first act is the acquisition of foreign assets by the central bank from a commercial bank by issuing bank reserves and depositing them on the accounts of this bank at the central bank. If the intervention was terminated at this stage, the commercial bank would be left with unwanted bank reserves and would try to sell them in the interbank market, driving interest rates in that market down. Since the central bank also wants to keep the interbank interest rate on its target, it intervenes in a second moment by selling some of its government securities to

commercial banks through open-market operations, thereby removing the excess liquidity from the interbank market. The final result of the operation is that the central bank swapped some of its treasuries for foreign assets.

This example highlights the first challenge posed by the acquisition of international reserves to monetary policy implementation: the availability of suitable instruments for monetary policy implementation. If the central bank is allowed to issue its own bonds or to offer remunerated deposit facilities, this will pose no problem as it will be able to continuously expand its liabilities. However, it might be the case – like in Brazil – that the central bank is legally forbidden to issue its own interest-earning liabilities.[7] In such a situation, the central bank must have an adequate stock of treasuries in its own portfolio to keep absorbing the reserves created during the acquisition of foreign assets – be it through open-market operations or through reverse repos. If not properly institutionalized, the transfer of treasuries to the central bank will occur in an ad hoc manner, politically subordinating the central bank to the treasury and possibly undermining its ability to keep the interest-rate on target.

5.4 Profits, losses, and the capital needs of central banks

According to Vaez-Zadeh (1991), central banks were historically profitable institutions as a consequence of the seigniorage gains they made by issuing the national currency and of the almost inexistent interest expenses they had on their liabilities. This configuration arises whenever central banks maintain a lean balance sheet in which banknotes and compulsory unremunerated reserves make the bulk of their liabilities (Nagel, 2012). One important consequence of the expansion of central banks' balance sheets after the accumulation of international reserves was that they increased substantially the possibility of losses in these institutions, which could eventually lead to negative equity. It, therefore, raises an important question: can central banks go bankrupt?

To understand the issue of profitability in central banks and answer this question, we derive a "profits" equation from a stylized central bank' balance sheet[8] (Table 5.2) in order to identify the major sources of potential losses that might arise:

[7]This prohibition was formalized in the Fiscal Responsibility Act (complementary law 101, widely known as "*Lei de Responsabilidade Fiscal*") in 2000.

[8]Many authors did derive similar "profit equations" from a central bank balance sheet (e.g. Bindseil (2004); Buiter (2007); Mendes (2016); Sweidan (2011); Vaez-Zadeh (1991)). Our work in this section is indebted to these authors.

Table 5.2: Stylized central bank balance sheet

Assets	Liabilities
Foreign assets (claims on non-residents)	Foreign liabilities
Domestic government securities	Currency in circulation
Claims on domestic banks	Bank reserves
Other financial assets	Government deposits
	Central bank bonds
	Equity capital (own funds)

Adapted from Lavoie (2014, p. 467).

$$P = i_f FXA + i_1 GS + i_2 DB + i_3 OFA - (i_f FXL + i_4 BR + i_5 GD + i_6 CB) - OC + \Delta FV \quad (5.1)$$

Where P is profits, FXA is foreign exchange reserves, GS is domestic government securities, DB is claims on domestic banks and OFA is other financial assets; FXL is foreign liabilities, BR is bank reserves, GD is government deposits and CB is central bank bonds; i_f is the relevant foreign interest rate; i_1 to i_6[9] are the respective interest rate related to each interest-rate-related item in Equation 5.1; OC are the operational costs of the central bank and ΔFV is the fair value variation of items in the balance sheet. In Table 5.2, this last item would affect mainly the foreign currency-denominated items and the other financial assets.

Equation 5.1 can be divided into three parts. The first comprehends the interest rates-related incomes and expenses and will be profitable whenever $i_f FXR + i_1 GS + i_2 DB + i_3 OFA > i_f FXL + i_4 BR + i_5 GD + i_6 CB$. The second and third part corresponds to the operational costs of the central bank and the fair value variation (capital gains or losses) of the central bank on its assets and liabilities. It is clear that if unremunerated bank reserves and currency in circulation are the main components of the liabilities of a central bank it will most likely be a profitable institution. Nonetheless, foreign assets and liabilities and other financial assets not only increase the chance of losses on the interest rate bill but also increase the variability of the fair value component of the central bank's results.

[9]Some central banks pay interest on (part) of their reserves and others do not.

Until the 2010s the literature emphasized the importance of quasi-fiscal activities[10] – that included capital losses derived from foreign exchange variations but also the acquisition of non-performing assets to rescue insolvent financial institutions, for instance – as the main source of central bank losses. The main conclusion of this early literature was that central bank losses would not only impair the reputation of central bankers but could also force an expansion the monetary base with deleterious effects to anti-inflationary policies (Robinson and Stella, 1993; Stella, 2005; Teijeiro, 1989; Vaez-Zadeh, 1991). It is important to note that most of the cases analyzed by this early literature focused on the central bank losses in the inflationary context of the late 1980s and early 1990s,[11] particularly in Latin America, in which the central banks incorporated to their balance sheets many non-performing assets from the private sector and significant foreign liabilities in the aftermath of the external debt crisis of the 1980s. One important consequence of this older balance sheet structure is that the exchange rate risk was concentrated on the liability side of the central bank' balance sheet, and a depreciation of the domestic currency would not only increase the necessary amount of domestic currency to fulfill interest rate obligations in foreign currency but would also increase the value in domestic currency of foreign currency-denominated liabilities. As we are going to see, this situation changed considerably with the accumulation of international reserves in NIEs.

In any case, it was this early literature that triggered the debate about the importance of capital in central banks, with a new surge in the 2010s after the expansion of the balance sheets of central banks in developed countries as a consequence of quantitative easing policies.[12] One of the first conclusions of this literature is that, from a technical perspective, negative capital in central banks does not impair their ability to achieve their monetary policy operational targets. As Bindseil et al. (2004, p. 23) argue, as long as the central bank does not have any liability in foreign currency and retains the privilege of legal tender,

> "Central bank capital [...] does not seem to matter for monetary policy implementation, in essence, because negative levels of capital do not represent any threat to the central bank being able to pay for whatever costs it has. Although losses may easily accumulate over a long period of time and lead to a huge negative capital, no reason emerges why this could affect the central bank's ability to control interest rates" (Bindseil et al., 2004, p. 23).

The fact that central banks retain the legal right to issue the domestic currency rules out the possibility of the central bank becoming illiquid or insolvent in the domestic

[10] According to Vaez-Zadeh (1991, p. 74), quasi-fiscal activities refer to the activities of the central bank that are not directly related with preserving price stability. They include: "domestic debt management, foreign reserves and exchange rate management, prudential supervision and deposit insurance, financial sector development, economic development, and income distribution."

[11] Not surprisingly, there was a surge in the literature about losses and accounting in central banks in the end of the 1980s and early 1990s (Fry, 1993; Robinson and Stella, 1993; Stella, 1997; Teijeiro, 1989; Vaez-Zadeh, 1991).

[12] See, for instance, Buiter (2008); Chiacchio et al. (2018); De Grauwe and Ji (2013).

currency. Bunea et al. (2016, p. 14), in an ECB working paper, synthesizes the point: "[c]entral banks are protected from insolvency due to their ability to create money and can, therefore, operate with negative equity." Therefore, if central banks are not indebted in foreign currencies, they cannot become insolvent.[13]

However, permanent losses could impair the reputation of central bankers, which could, in turn, affect their capacity or their independence to implement their desired monetary policy. Vaez-Zadeh (1991), for instance, noted that the authority of the central bank to regulate the financial system could be eroded if the markets perceived their finances to be unsound. This line of argument would be later developed by many authors, particularly by Stella (e.g. 1997; 2005), a researcher from the IMF who emphasizes that only a financially strong central bank could credibly commit to anti-inflationary policies if they were to generate losses for the central bank. Therefore, if central banks are not financially strong their policies are going to be tested by market agents empowered with rational expectations, and persistent losses would lead to expectations of higher future inflation. There would also be a concern that losses at the central bank would require the recapitalization of the bank by the local treasury. For Stella (2005), even automatic schemes of recapitalization would politically subordinate the central bank to the government and could harm its independence.[14] Therefore, central bankers incurring in persistent losses would finally relax their anti-inflationary stance in order to reduce the losses at the central bank and preserve their independence. One should note the circularity of this argument: it is the fear that losses will impair the autonomy of the central bank to pursuit anti-inflationary policies that triggers the relaxation of the anti-inflationary stance, and not the losses per se. Another perspective on this issue was raised by Archer and Moser-Boehm (2013) and Caruana (2013), from the BIS. According to these authors, negative capital is a problem for central banks not because they threaten their operational capacity but because important stakeholders – notably the government and market participants – can fail to recognize the difference between a central bank and a commercial bank and react to losses in such ways that would damage the transmission mechanism of central bank policies or undermine the political independence of the central bank. As Caruana (2013, p. 1), a former General Manager of the BIS argues, "the problem is that not everyone appreciates that a central bank's accounting equity can be negative without any reason for alarm bells to ring. Markets may instead react badly in the false belief that losses imply a loss of policy effectiveness."

Therefore, the literature seems to agree that financial strength in central banks is important to successfully achieve their policies, even if the reasons for it is a misperception

[13]This point was noted by many authors from different theoretical backgrounds (Archer and Moser-Boehm, 2013; Bell, 2001; Chiacchio et al., 2018; Lavoie, 2014; Robinson and Stella, 1993; Schwarz et al., 2015; Sweidan, 2011; Vaez-Zadeh, 1991).

[14]This last point is not consensual, however. For Bindseil (2004, p. 30), a clear recapitalization rule is a "full substitute for capital in so far as it is unconditionally automatic."

of the main stakeholders about the nature of a central bank. There is an important but unexpected development that followed the accumulation of international reserves in NIEs in the 2000s and 2010s that is connected to this issue: it looks like that the link between central banks' results and price stability in many of these countries was reversed and central banks that were being successful in reducing inflation were also experiencing losses in their accounts.[15] To understand this development, it is important to keep in mind that inflation rates have dropped worldwide since the end of the 1990s and that the accumulation of international reserves means that central banks reduced their foreign liabilities to insignificant levels and raised substantially their foreign assets. Furthermore, non-performing assets in the balance sheets of NIEs' central banks were also reduced to unimportant levels in many cases. On the other hand, the importance of interest-rate earning liabilities increased as a consequence of the compensation of this accumulation. To see the effect of these changes, we can rewrite equation (1) with some simplifying assumptions: i) the economy is running in an asset-based system in which the central bank holds no claim on domestic banks ($DB = 0$) nor any other financial asset ($OFA = 0$); ii) that the central bank holds no liabilities denominated in foreign currencies ($FXL = 0$); and iii) that the operational costs of the central bank are equal to zero, for simplicity. We also aggregate the remunerated bank reserves at the central bank and the central bank bills as "interest-earning liabilities" (IEL) at the central bank, in order to have only one liability that is not related to other entities of the public sector. These liabilities are remunerated by the weighted average interest-rate between i_4 and i_6, that we will refer to as i_d. Therefore, the profits of this stylized central bank are equal to:

$$P = i_f FXA + i_1 GS - (i_d IEL + i_5 GD) + \Delta FV \tag{5.2}$$

However, since interest-rate income on government securities and the interest-rate expenses on government deposits are closed inside the overall public sector, we could derive from Equation 5.2 a profits equation of the central bank with the non-public sector, that is equal to:

$$PNPS = i_f FXA - i_d IEL + \Delta FV^* \tag{5.3}$$

Where $PNPS$ stands for profits with the non-public sector and the star means that the fair value variation relates only to FXA and IEL items. In the Brazilian case, for example, the i_d is closely related to the operational interest-rate target of the BCB and the IEL liabilities are mostly price invariant. In such cases the ΔFV^* item can be assumed to concern only the foreign assets held by the central bank.

[15] Archer and Moser-Boehm (2013) cites Mexico, Israel, Chile and Czechia as examples of this development.

The central bank' profits with the non-public sector can then be divided between its interest-rate-related component ($i_f FXA - i_l IEL$) and the fair value variation on its foreign assets – which is largely determined by the variation of the exchange rate.[16] Since the relevant foreign interest rate is generally lower than the domestic operational interest rate, the interest rate component – which mainly represents the carrying costs of the international reserves[17] – is usually negative.[18] However, in countries with significant foreign exchange reserves and floating exchange rate regimes, the overall result of the central banks tends to be dominated by the fair value component given the relative size of the foreign assets in the balance sheet. The results of NIEs' central banks thus became more volatile and connected to the variability of their currencies. It is important to emphasize that, contrary to what was common at the end of the 1980s and 1990s, a depreciation of the domestic currency nowadays generally implies higher profits of the central bank as it increases the value of its foreign assets while an appreciation of the domestic currency implies unrealized losses for the central bank.

Since the exchange rate is also associated with the variation of domestic prices through the price of imports, this new situation led many researchers to claim that NIE's central banks that successfully achieved price stability would attract foreign capital and, as a consequence, would experience an appreciation of their currencies that would lead to "good" or "benign" losses while central banks that failed to achieve price stability would also see their currencies depreciate in nominal terms, generating "bad" retranslation profits as a consequence (Archer and Moser-Boehm, 2013; Bholat and Darbyshire, 2016; Frait and Holub, 2010). Or it could be the case that some governments took advantage of the recent financial integration to the world economy to open their financial accounts and set relatively high-interest rates in order to attract financial flows, expecting that it would lead to the appreciation of their currencies and help them to achieve their anti-inflationary policies. Regardless of the direction of the causation, a negative association between central banks' results and the success of inflation targeting emerged in many NIEs in the 2000s

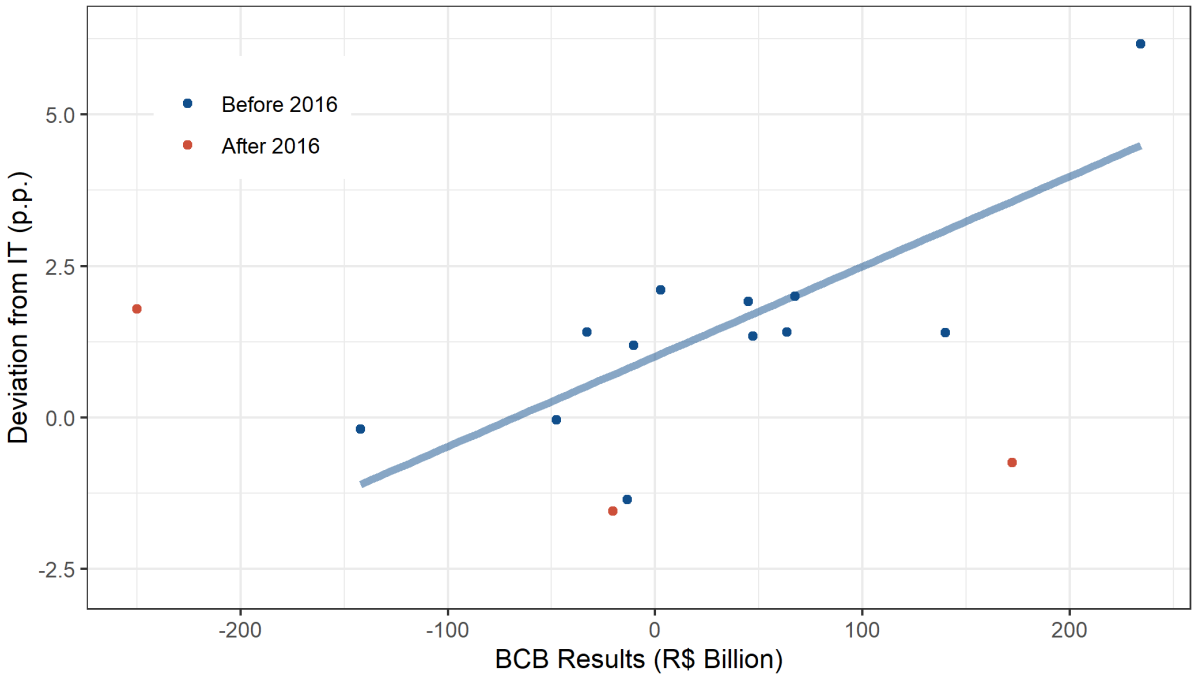
[16] We define the exchange rate in its direct quotation, i.e., the price of a unit of foreign currency in units of domestic currency.

[17] For the sake of precision, it is important to note that the *IEL* stocks also includes liabilities that were not created to compensate the accumulation of reserves. Government expenditures not funded by tax income nor debt issuing would also entail, ceteris paribus, the expansion of *IEL* at the central bank. Similarly, the remuneration of the *IEL* itself will also need to be compensated, leading to further increases of *IEL*s at the balance-sheet of the central bank that are not technically carrying costs.

[18] The interest rate component depends not only on the interest rate differential but also on the difference between the *FXA* and *IEL* stocks. If a central bank compensates the acquisition of international reserves by increasing the non-remunerated reserve requirements at the central bank, for example, the relative size of *FXA* in relation to *IEL* might overweigh the effect of the interest rate differential and the interest rate component might turn positive.

and 2010s. Figure 5.1 shows this relationship in the Brazilian economy between 2004, the start of the rise in international reserves, until the crash of the economy in 2015.[19]

Figure 5.1: Bad profits and good losses? BCB results, 2004 - 2018.



Source: BCB.
Note: "IT" means "inflation targeting" and the "BCB results" are the annual sum of the operational results and the foreign exchange results of the BCB.
Author's elaboration.

Therefore, it is difficult to foresee a situation in which the outcome of this type of central bank losses would be inflationary. As was argued above, most of the central banks' losses in NIEs are connected to carrying costs of international reserves and negative fair value variation of foreign assets. These sources of losses are not likely to be related to inflationary pressures since the former is a consequence of high base interest rates and the latter a consequence of an appreciation or valorization of the local currency. Furthermore, if central bank losses are not realized, they cannot directly threaten price stability, since there is no change whatsoever in the overall liquidity of the economy.[20] Nonetheless, it is almost consensual among central bankers that they should be concerned with the financial strength of their institutions. Accounting practices are not neutral in this regard as they affect the volume of profits and losses that are reported by the central banks. Before moving to the details of the Brazilian experience, we are going to review the

[19]This relationship appears to be broken since 2016. However, it is important to note that the last half of the 2010s was marked by a profound recession in the Brazilian economy and high levels of unemployment that are keeping prices under control more or less independently of the exchange rate.

[20]This point was early recognized by Vaez-Zadeh (1991, p. 77), who, although working within a monetary targeting framework, emphasized that, from a macroeconomic perspective, losses are a problem only if they cause an injection of liquidity in the economy.

main differences between the most common accounting frameworks in their treatment of international reserves and foreign exchange operations.

5.5 The main accounting frameworks

The objective of this section is to compare the different treatment given by the main accounting frameworks in central banks to international reserves and the profits and losses derived from their management. The most common accounting frameworks are the International Financial Reporting Standards (IFRS), often adapted to local specificities, and the European System of Central Banks (ESCB) accounting system, that is adopted mainly in Europe (Archer and Moser-Boehm, 2013; Bunea et al., 2016; KPMG, 2012).

In general, the balance sheets of central banks are denominated in their local currency. The main problem that concerns us is how to account for the assets and liabilities denominated in foreign currencies. One way would be to record these values at their historical cost, i.e., the price in the local currency of these assets or liabilities when they were added to the balance sheet of the central bank. Another option is the implementation of the fair value method that uses market prices in every period to recognize those assets and liabilities. Nowadays, fair value accounting is widespread among central banks (Archer and Moser-Boehm, 2013; Bunea et al., 2016). However, as we saw in section 5.4, the adoption of fair value methods in central banks increase the volatility of their profits and losses due to the exchange rate retranslations of their assets.[21] The main difference between the IFRS-based and ESCB-based accounting frameworks is that the former recognizes these variations directly in the income statement while the latter transfers them to a buffer account that is depleted in the case of future unrealized losses.[22]

How these different accounting frameworks will affect the capacity of central banks to undertake their policies will depend on the nature of the relationship between the central bank and the treasury – particularly on how profits and losses of the central bank are distributed to the government. According to Bunea et al. (2016), the distributional arrangements between central banks and treasuries are generally asymmetrical, in the sense that profits are paid out to the government while losses are held at the central bank, sometimes implying negative equity for these institutions. From the 57 central banks analyzed in their work, only 20 have mechanisms that ensure a direct recapitalization of the central bank by the treasury. Even in these cases the recapitalization usually occurs only after all buffers, including the capital of the central bank, have been depleted.

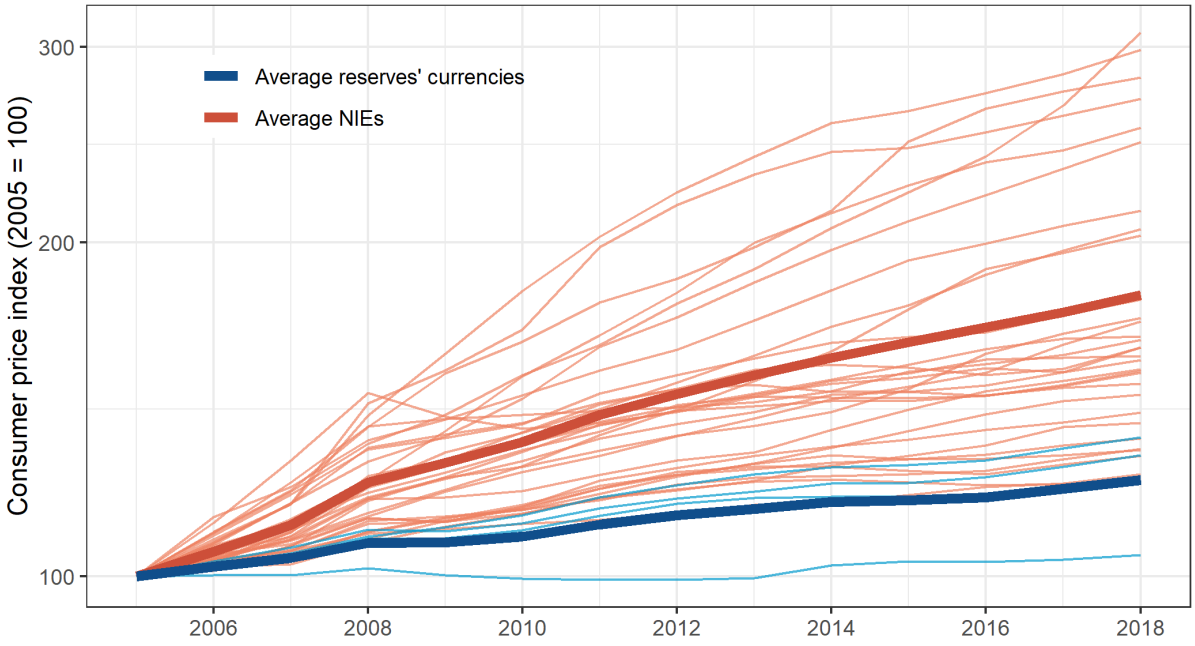
Therefore, one important consequence of the recognition of unrealized results in the income statement is that it increases the distribution of profits to the government, on the

[21] International reserves are mainly hoarded in safe short-term foreign government securities. As a consequence, their value in foreign currency is not subject to significant price risk.

[22] These are also referred as the "income approach" and the "equity/liability approach", respectively (KPMG, 2012).

one hand, and the necessity to recapitalize the central bank if it is not allowed to run with negative equity, on the other. Historically, central bankers argued that the adoption of fair value methods would not only increase the transparency of their accounts but also would foster their credibility by adopting standards that are common to the private sector (Archer and Moser-Boehm, 2013). However, as many authors pointed out, the distribution of unrealized gains can lead to monetized financing of fiscal expenditures (e.g. Cervantes (2007)). Therefore, Sullivan (2000), a researcher from the IMF, recommends as a good practice that unrealized losses should be recognized in the income statement but ring-fenced from distribution to the treasury.

Figure 5.2: Evolution of consumer price indices, several countries, 2005-2018.



Sources: IMF and BIS.
Author's elaboration.

In other central banks, especially those that adopt the ESCB accounting framework, the income statement only recognizes profits and losses that are realized. Unrealized results, in this framework, are transferred to a revaluation account. The ESCB framework also imposes its own asymmetrical treatment of profits and losses, based on the prudence principle that guides the legal and financial reporting of the central banks in this system. According to guidelines of the EU (2016)[p. 347-348], the prudence principle implies that "unrealized gains shall not be recognized as income in the profit and loss account, but shall be recorded directly in a revaluation account and that unrealized losses shall be taken at year end to the profit and loss account if they exceed previous revaluation gains registered in the corresponding revaluation account." Therefore, unrealized losses that cannot be covered by the existing revaluation buffers must be covered by the respective

treasuries. On the other hand, all realized results are recognized immediately in the income statement. In this case, the bulk of the variability of the central bank results would be transferred to revaluation accounts, and the final accounting results become less volatile as a consequence (Schwarz et al., 2015). However, nations and their central banks in the Eurozone (more so in the periphery of the Eurozone like in Greece) lack full political sovereignty over their money[23] and face constraints that are similar to those faced by central banks indebted in foreign currencies (Lo Vuolo and Pereira, 2018). More prudence is desirable in this situation.

The adoption of a plain ESCB accounting framework may also have unintended consequences in NIEs and other developing economies. As we can see in Figure 5.2, NIEs' currencies usually present higher inflation rates than the currencies in which foreign assets are denominated.[24] Therefore, even if real exchange rates trajectories are unpredictable, it is likely that, in the long run, nominal exchange rates will depreciate more than appreciate in NIEs, leading to inflated financial buffers in their central banks if they adopt the ESCB framework. A simple estimation of the capital gains on international reserves in a group of NIEs corroborates this intuition.[25] According to Godley and Lavoie (2007, p. 135), capital gains can be calculated as the price variation of an asset multiplied by its stocks in the previous period. We use this definition to make a rough estimation of the yearly capital gains stemming from the international reserves in a group of NIEs, which is presented in Figure 5.3. It is important to note that we assumed that all reserves were held in US dollars to simplify the estimation. The initial stocks were the ones verified in 2002, in order to capture the commodity boom of the 2000s.[26]

As it is clear from Figure 5.3, almost all of the NIEs in the sample experienced positive capital gains in the period. It is also interesting to note that 3 of the 4 countries that experienced negative accumulated capital gains – Israel, Czechia, and Thailand – are

[23] Wray (2015, p. 43) goes as far as to argue that the "Euro is effectively a 'foreign' currency from the perspective of the individual nation."

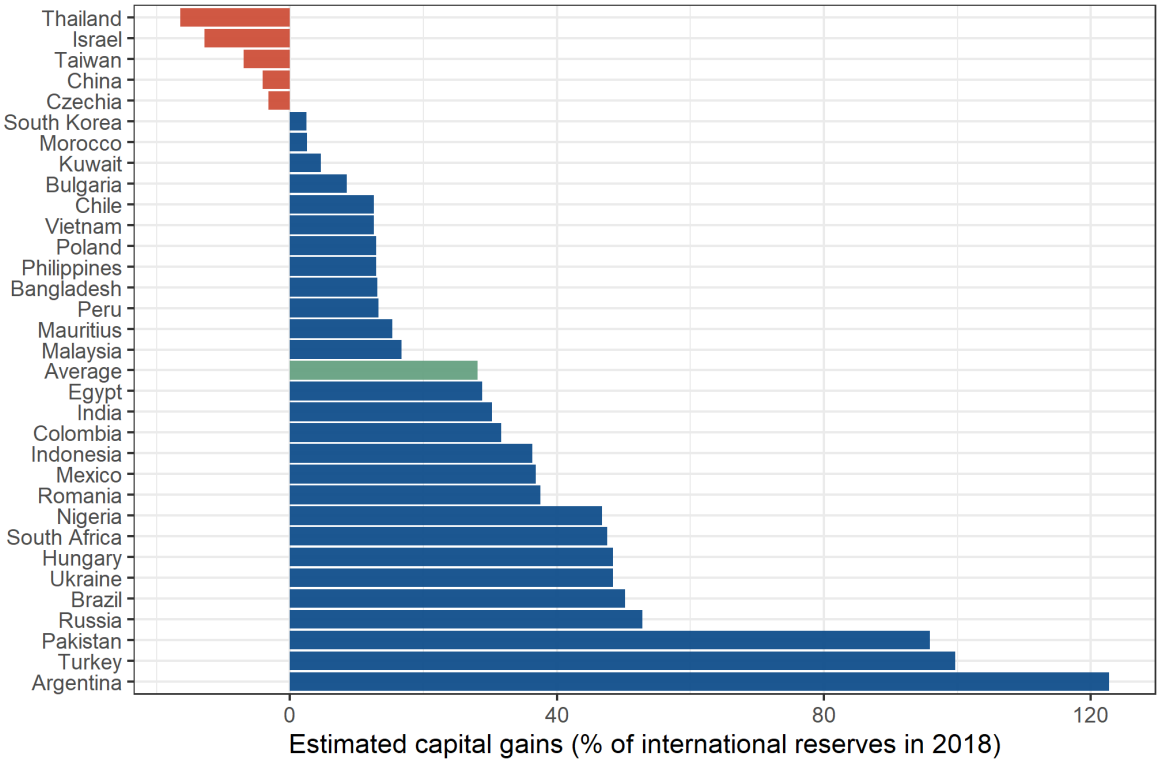
[24] International reserves are meant to be safe, and, thus, it is not reasonable to save them in inflation-prone currencies. The sample starts in 2005 and finishes in 2018. The NIEs group includes: Argentina, Bangladesh, Bulgaria, Brazil, Chile, China, Colombia, Czechia, Egypt, Hungary, Indonesia, Israel, India, Iran, Korea, Kuwait, Mexico, Malaysia, Nigeria, Oman, Peru, Philippines, Pakistan, Poland, Qatar, Romania, Russia, Saudi Arabia, South Africa, Taiwan, Thailand, Turkey, Ukraine, United Arab Emirates, Venezuela, Vietnam. The countries with the 4 highest consumer price indices in 2015 (Argentina, Egypt, Ukraine and Nigeria) were excluded, as well as the Iran, Taiwan and Venezuela due to lack of data. The reserves' currencies group are the United States, United Kingdom, Japan and the Eurozone. The consumer price index for the Eurozone was calculated as the average consumer price index of all member countries at the respective year.

[25] We use the same group of NIEs as before. Venezuela was excluded due to missing data and Qatar, Oman and Saudi Arabia were excluded given the absence of any nominal exchange-rate variation in the period.

[26] The capital gains were measured annually, and the total accumulated at the end of 2018 was converted back to US dollars by the exchange rate of the end of 2018. This value was then compared to the total stocks of international reserves at the end of 2018.

among the 4 countries with the lowest consumer price indices in 2018.[27] This evidence suggests that the implicit hypothesis of symmetrical nominal foreign exchange rate shocks behind the ESCB rule of setting aside all unrealized gains – a reasonable hypothesis for the euro – should be relaxed in NIEs in order to avoid the creation of inflated financial buffers.

Figure 5.3: Estimated capital gains, several countries, 2002-2018



Source: IMF.
Author's calculations.

Before finishing this section, it is important to summarize the main aspects of the discussion so far. First, it should be clear that unrealized central bank's profits will only have an objective impact on the economy if they are spent in the economy. In this case, the central bank will have to compensate and remove the extra liquidity from the system in order to keep the short-term interest rate on target. A similar type of compensation will be necessary if the central bank is incurring realized losses (e.g. the carrying costs of international reserves). If the central bank is allowed to issue its own interest-earning liabilities or to remunerate deposits held by commercial banks in its own accounts, this compensation would not require the participation of the treasury and the central bank would not be constrained even by negative equity – although reputational issues might arise in this case.

[27] And China does not fall far behind, being the country with the seventh lower value of the consumer price index in 2018.

However, if the central bank is not allowed to issue interest-earning liabilities, it must rely on an adequate supply of bonds by the government to keep the interest rate on target. In this case, problems may arise. Even though we think that the central bank and the government should be aligned to implement the best mix of economic policies, in many cases the central bank is formally independent of the treasury and free to execute the monetary policy at its will. If an independent central bank needs treasury bonds to achieve its operational target, the compensation of the accumulation of foreign exchange reserves and other realized expenses might exhaust its portfolio of free treasury bonds. If, in this case, the authorities at the treasury think that the target interest rate is higher than it should be, they could delay the recapitalization of the central bank and force a reduction of the target interest-rate. Although this possibility is emphasized by Stella (2005), we think that such an open conflict of interest would severely harm not only the reputation of the central bank but also of the treasury and would be avoided in most cases. In any case, transparent and unconditional rules governing the recapitalization of the central bank would minimize these risks (Bindseil et al., 2004).

Beyond this objective constraint, it is true that political conflicts between the government and the central bank over what is the adequate monetary and exchange rate policies mix can arise, especially if the central bank is having persistent losses – which increases the overall public sector debt – that must be covered by the treasury. In general, the losses of central banks are covered by the issue of government securities that are automatically and costlessly transferred to the central bank, thus raising its equity, without passing through the market (Bunea et al., 2016). This scheme minimizes the burden on the treasury since it is technically unconstrained to issue new bonds. However, a transfer scheme in which the treasury must cover the losses of the central bank by using its liquid resources could technically constrain the treasury since it could require the utilization of tax receipts or the issuance of primary debt to cover for those losses. This would in turn place the monetary policy expenses at par with other governmental expenses and would arguably increase the political pressure of the treasury on the central bank to modify its policies in order to reduce its losses, impacting the autonomy of the central bank to properly implement its foreign exchange policies.

5.6 The Brazilian experience

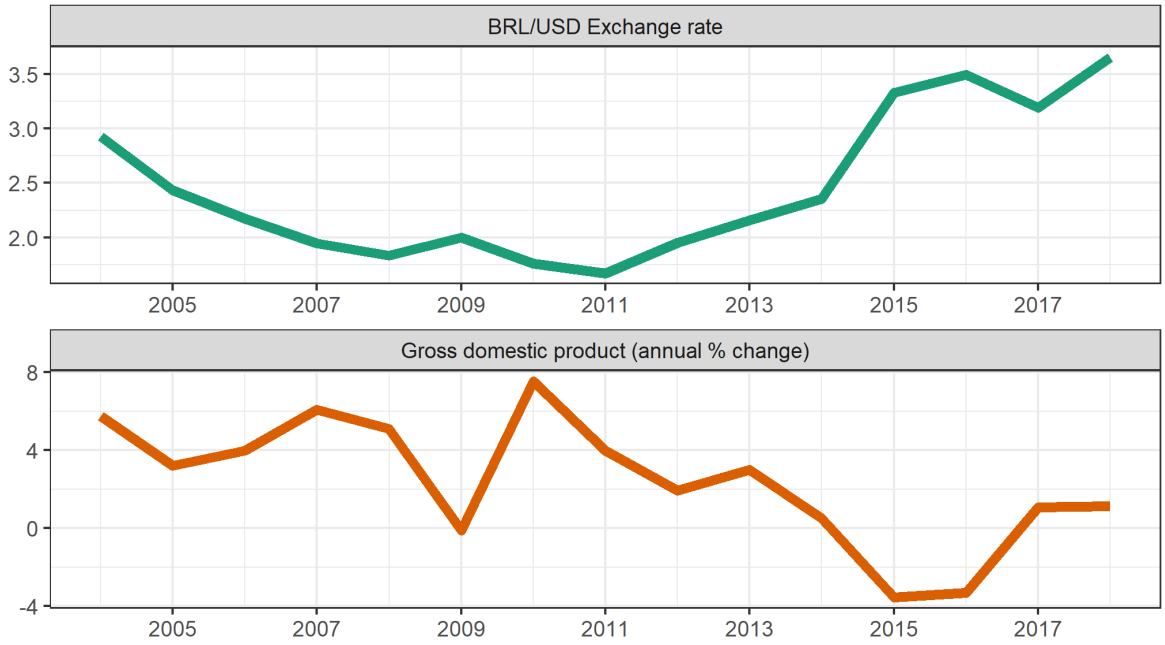
Since the rise of international reserves held by the Brazilian Central Bank in the mid-2000s, the Brazilian authorities changed twice the accounting framework that regulates the accounting of the foreign exchange rate policies of the Brazilian Central Bank and its relationship with the Brazilian Treasury. The objective of this section is to understand what motivated these changes, and how different accounting frameworks would affect the autonomy of the BCB to undertake its policies. To achieve this objective, the section starts

with a brief contextualization of the Brazilian economy in which these changes took place. We will then detail the main aspects of the accounting framework implemented in 2008 and summarize the debate around its failures, which ultimately led to the new legislation implemented in 2019. To illustrate some of the points we make and to understand the implications of the different accounting frameworks, we use the available data on the realized and unrealized results of the central bank to simulate how the developments would have been under the new accounting framework, as well as how it would have been under the ESCB framework, commonly referred as the best international standard by the literature.

5.6.1 Context

As we can see in Figure 5.4, the Brazilian economy experienced a fairly stable growth rate between 2004 and 2013. However, the deterioration of the domestic and international conditions in 2014 led to the dramatic fall of the GDP growth rate in 2015. In this same period, the BRL/USD exchange rate appreciated steadily until 2011 when the trend changed towards the depreciation of the BRL. Although this depreciation was somehow moderated until 2014, the percentage variation of the average exchange rate from 2014 to 2015 alone was bigger than 40%. It remained at a fairly depreciated level since then.

Figure 5.4: Evolution of the BRL/USD exchange rate and the Brazilian GDP, 2004-2018



Sources: IMF-IFS and WB.
Author's elaboration.

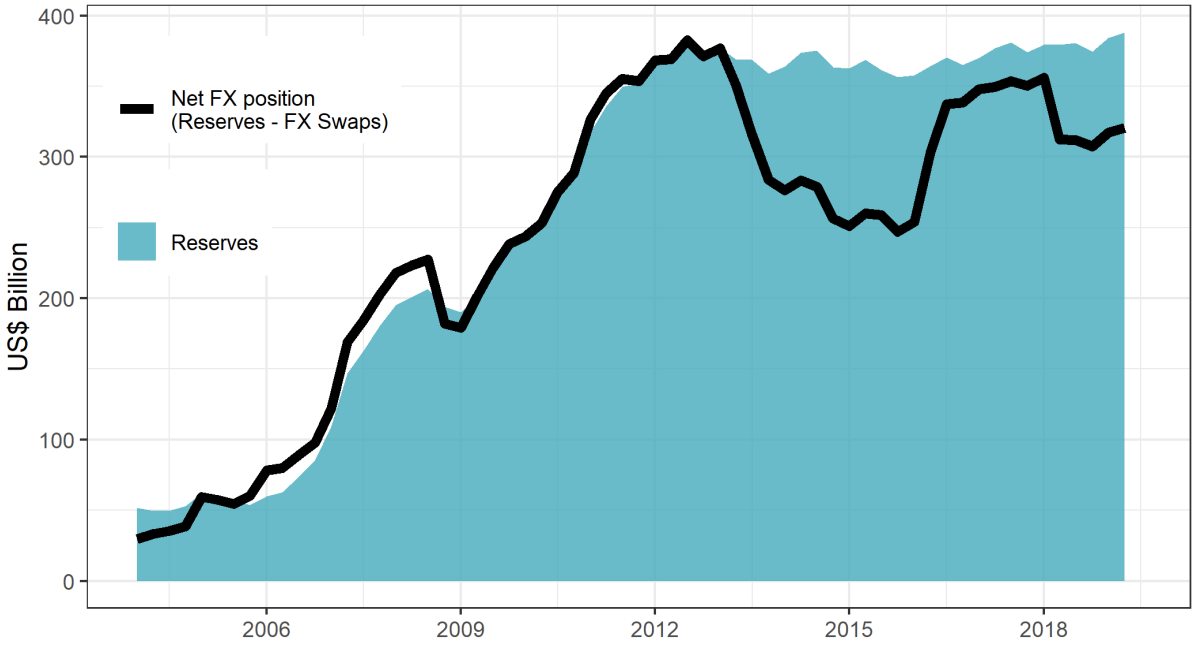
During this period, the Brazilian authorities hoarded a significant amount of foreign assets. As we can see in Figure 5.5, this expansion was particularly marked between 2006

and 2011. The BCB also intervened significantly in the future foreign exchange markets through the issue of foreign exchange swaps (FX swaps), particularly between 2013 and 2015, when the notional value of the exposition of the BCB in U.S. dollars in these contracts amounted to more than 100 billion. The official reason behind the utilization of the FX swaps is the necessity to provide hedge opportunities to market participants indebted in foreign currency, preserving the financial stability of the economy. These policies had a significant impact on the balance sheet of the BCB, as can be seen in Table 5.3. The value of foreign assets jumped from 6.5% of the Brazilian GDP in 2005 to 23.5% in 2018, peaking at almost 25% in 2015. The acquisition of these foreign assets was mainly compensated by the issuance of reverse repos that increased steadily in the period under investigation and were, at the end of 2018, equivalent to more than 17% of the Brazilian GDP (Macedo e Silva, 2016).

Table 5.3: BCB balance sheet, selected items (% of the GDP).

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Assets														
Foreign Assets	6.5	8.3	13.2	16.5	12.9	12.8	15.4	16.3	16.9	17.5	24.5	20.6	20.7	23.3
Govt. Securities	13.0	12.6	13.2	16.0	19.2	18.1	17.2	18.9	17.9	19.3	21.3	24.2	25.3	26.1
Liabilities														
Bank reserves	4.8	4.9	5.4	2.9	2.9	9.8	9.7	6.6	6.9	5.6	6.1	6.5	6.9	6.4
Reverse Repos	2.9	3.2	7.0	11.1	13.6	7.4	8.0	12.4	10.7	14.5	16.1	17.3	16.6	17.1
Govt. Deposits	9.7	9.4	10.2	14.1	12.4	10.6	13.2	13.2	12.9	12.1	17.3	16.8	16.6	18.9
Currency in circulation	3.2	3.6	3.8	3.7	4.0	3.9	3.7	3.9	3.8	3.8	3.8	3.7	3.8	3.8
Equity capital	0.4	0.6	0.0	0.5	0.6	0.4	0.4	0.4	0.3	0.3	1.7	2.0	1.9	1.8

Figure 5.5: Stocks of international reserves and net FX position (international reserves minus notional value of open FX swap contracts) held by the BCB, 2004-2018



Source: BCB.
Author's elaboration.

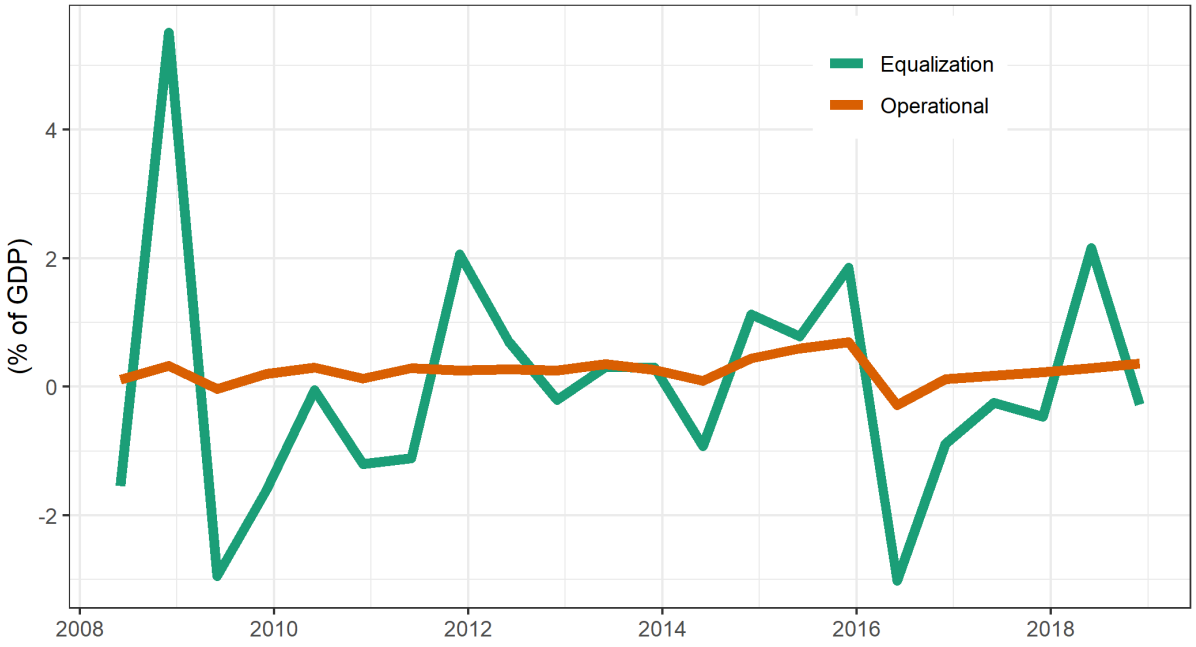
5.6.2 The evolution of the Brazilian accounting framework

It was only in 2007 that the BCB finished implementing the IFRS framework. However, the authorities at the BCB and at the BT soon realized that the recognition of the fair value variation of the foreign assets held by the BCB in its income made its results "excessively volatile" (Brasil, 2008, paragraph 9) (Brasil, 2008, paragraph 9). In the same document, the authorities also expressed the concern that the monetary operations aimed to compensate for the accumulation of foreign assets would deplete the BT bonds on the portfolio of the BCB. Therefore, they proposed an amendment to the existing legislation that would insulate the BCB's results from its foreign exchange operations and would also provide the necessary volume of bonds to keep the central bank operational. This legislation was approved later in 2008 as the law 11,803 and had important consequences that shaped the relationship between the BCB and the BT between 2008 and 2019.

To fix the excessive variability of the BCB results and avoid the potential damage to its reputation, the law 11,803 defined that, from 2008 onwards, the semiannual results of the BCB would be divided between the results related to all the foreign exchange operations and the rest of the operational results of the central bank. The foreign exchange results should also be explicitly divided between everything that was related with the management of the international reserves – including the fair value variation of these assets and the carrying costs involved in holding these assets – on the one hand, and the

expenses and earnings associated with the operations of the central bank with foreign exchange derivatives – mainly with foreign exchange swaps –, on the other hand. The two parts of the foreign exchange operations would then be discounted from each other and entirely transferred to the BT through the equalization operation. In the case of profits, the BT account at the BCB would be credited; in the case of losses, the BT would have to cover the losses. The remaining results of the central bank after the equalization operation would then be the result of the BCB as reported in its financial statements and would also be transferred to BT. The law also determined that up to 25% of the operational result could be used to feed financial buffers for rainy days at the central bank.[28] One can see in Figure 5.6 that the introduction of the equalization operation effectively insulated the BCB results from the volatile foreign exchange results in the period.

Figure 5.6: Equalization and operational results of the BCB, 2008-2019



Source: BCB – *demonstrações financeiras*.
Author's elaboration.

To provide an adequate portfolio of treasury bonds at the BCB, the law 11,803 allowed the BT to issue securities that could be used in monetary policy operations and transfer them directly to the BCB. The BT was also allowed to cover the losses of the BCB – be it on the equalization or on the operational account – with the issuance of bonds under the same conditions. This is the second important aspect of the law 11,803. The law 11,803 also established – although in an imperfect manner – that whenever the stocks

[28] Mendes (2016) criticizes this rule for being inconsistent with the variability of the foreign exchange operations. This critique ignored that the equalization operation was created exactly to shield the result of the BCB from its foreign exchange operations and that it would not make sense to constitute any additional buffer for it.

of free government securities (i.e., securities not dedicated to any reverse repo) in the BCB portfolio were below a certain threshold, the BT would issue bonds and transfer them to the BCB. This regulation was further clarified in 2009 when a floor-threshold of 20 billion BRL in BT bonds was defined as the level that would trigger an automatic recapitalization of the BCB (Tesouro Nacional, 2013). On the other hand, any profits made at the central bank would be transferred to the BT in the form of money, that would be deposited in the account of the government at the central bank. Although an obvious choice – doing otherwise would deprive the central bank of government bonds that it would later need to execute its monetary policies –, this asymmetry, tied to the full transfer of the equalization operation, was responsible for the increase of the government deposits in the balance sheet of the BCB, as can be seen in Table 5.3 above (De Conti, 2016; Mendes, 2016). Even if often criticized for enabling the BCB to unintentionally finance the BT (Carvalho Jr., 2016; Garcia and Afonso, 2016; Guardia, 2016; Mendes, 2016), we think that allowing the BT to issue government securities and to transfer them to the BCB without passing through markets was crucial to guarantee the autonomy of the BCB to undertake its policies.

Nonetheless, the developments that followed the implementation of the law 11,803 raised important criticism among Brazilian economists (see, for instance, the book edited by Bacha (2016) that gathers many papers devoted to the issue) and led to the reform of the legislation in 2019. As we hinted before, the main criticism was that the transfer of unrealized results to the BT through the equalization operation provided an undesired source of financing to the government, softening its budget constraint. Although these resources were ring-fenced – they could only be used to pay for expenses related to the management of the public debt –, Mendes (2016) shows that these restrictions were bypassed in two ways: i) the government could shift sources of expenditures, using the unrealized profits of the BCB to pay for the interests on the government debt, liberating other resources to fund primary expenditures; and ii) even if the government deposits were not used, they were being remunerated by the operational interest rate at the central bank, and this remuneration was not as strictly ring-fenced as the deposits that originated them. One should note, however, that the practical consequence of this bypassing was the expansion of reverse repos in the liability side of the central bank, shortening the maturity of the overall public sector debt (Carbone and Gazzano, 2016).

The second criticism raised was that the equalization operation reduced the transparency of the BCB accounts (Mendes, 2016; Viana, 2018). Although claimed otherwise in the notes attached to the financial statements of the BCB,[29] there is little controversy about this criticism. It is clear from Figure 5.6 that the equalization operation was hiding the volatility of the BCB results and what would they have been if there was no separa-

[29] See, for instance, (BCB, 2015a, fl. 19)

tion between the foreign exchange operations and the rest of its operations. The actual numbers can also be seen in column h of Table 5.4.

Another critique against the law 11,803' framework questioned the consolidation of the realized and unrealized results inside the equalization account (Gallo, 2016; Garcia and Afonso, 2016; Mendes, 2016; Viana, 2018). These authors emphasize the importance of the prudence principle outlined in the ESCB framework that recommends that all unrealized losses should be held in a revaluation account while the realized results should be immediately recognized in the profits and losses statement. However, with the exception of Viana (2018) and Gallo (2016), the literature abstained to suggest something different. In Mendes' (2016) policy proposal, for example, the crucial aspect was to prevent the transfer of unrealized results to the treasury, and the division between realized and unrealized results was conveniently ignored. This might point to some form of pragmatism from the central bankers, that always noted that the consolidation of the different foreign exchange operations provided an important accounting hedge for the BCB to undertake its FX swaps operations in times of stress (BCB, 2015a; Farhi et al., 2018).

Table 5.4: Detailed results of the BCB (% of the GDP), 2008-2019

	Foreign exchange rate operations											
	Swaps[1]		International reserves				Realized FX results[7]	Equalization	Operational[8]	Total	Cost rate (% p.y.)[9]	Var. exchange rate (%)[10]
	Notional value[2]	Swaps results	Avg. reserves[3]	Gross results[4]	Carrying costs[5]	Net results[6]						
Period	*a*	*b*	*c*	*d*	*e*	*f = d - e*	*g = b - e*	*h*	*i*	*j = h + i*	*k*	*l*
2008-01	0.8	-0.2	11.3	-0.9	0.4	-1.4	-0.6	-1.5	0.1	-1.4	-7.7	-10.1
2008-02	-0.4	0.3	12.8	5.9	0.7	5.2	-0.3	5.5	0.3	5.8	-10.5	46.8
2009-01	0.0	0.1	13.7	-2.5	0.5	-3.0	-0.5	-2.9	0.0	-3.0	-7.3	-16.5
2009-02	0.0	0.0	12.1	-1.2	0.4	-1.6	-0.4	-1.6	0.2	-1.4	-6.6	-10.8
2010-01	0.0	0.0	12.2	0.4	0.4	-0.1	-0.4	-0.1	0.3	0.2	-7.1	3.5
2010-02	0.0	0.0	12.1	-0.7	0.5	-1.2	-0.5	-1.2	0.1	-1.1	-7.9	-7.5
2011-01	0.2	0.0	12.5	-0.5	0.6	-1.1	-0.6	-1.1	0.3	-0.8	-8.8	-6.3
2011-02	0.0	0.1	13.7	2.6	0.6	2.0	-0.6	2.1	0.3	2.3	-8.6	20.2
2012-01	-0.1	0.0	14.8	1.3	0.6	0.7	-0.6	0.7	0.3	1.0	-8.1	7.8
2012-02	0.0	0.0	16.0	0.3	0.6	-0.2	-0.6	-0.2	0.3	0.0	-6.8	1.1
2013-01	-0.4	0.0	15.1	0.9	0.5	0.3	-0.5	0.3	0.3	0.7	-6.9	8.4
2013-02	-1.4	0.0	16.0	1.0	0.6	0.3	-0.7	0.3	0.3	0.6	-7.8	5.7
2014-01	-3.6	0.4	15.5	-0.8	0.5	-1.3	-0.1	-0.9	0.1	-0.8	-6.1	-6.0
2014-02	-4.9	-0.5	15.7	2.6	1.0	1.7	-1.5	1.1	0.4	1.6	-11.9	20.6
2015-01	-5.7	-0.6	18.7	2.7	1.3	1.4	-1.9	0.8	0.6	1.4	-12.8	16.8
2015-02	-7.1	-1.1	22.8	4.8	1.8	2.9	-2.9	1.9	0.7	2.5	-15.1	25.9
2016-01	-3.2	1.3	22.6	-3.8	0.5	-4.3	0.8	-3.0	-0.3	-3.3	-4.2	-17.8
2016-02	-1.4	0.1	19.6	0.0	0.9	-1.0	-0.9	-0.9	0.1	-0.8	-9.4	1.5
2017-01	-1.4	0.1	18.6	0.6	0.9	-0.3	-0.8	-0.2	0.2	-0.1	-9.1	1.5
2017-02	-1.2	0.0	18.5	0.2	0.7	-0.5	-0.6	-0.5	0.2	-0.2	-7.1	0.0
2018-01	-3.8	-0.3	19.5	3.1	0.7	2.4	-0.9	2.2	0.3	2.5	-6.8	16.6
2018-02	-3.8	0.0	21.5	0.4	0.7	-0.3	-0.6	-0.3	0.4	0.1	-6.2	0.5
2019-01	-3.7	0.1	20.9	0.4	0.6	-0.2	-0.5	-0.1	0.3	0.2	-5.6	-1.1

Sources: BCB - Estatísticas fiscais, BCB - demonstrações financeiras and BCB - SGS.

Authors' elaboration.

1/ operations realized through auditions and registered at the B3.

2/ Notional value of the BCB exposition in USD. Negative values mean that the BCB has a short-USD position.

3/ Average international reserves in the period.

4/ Includes gains and losses from exchange rate retranslation, from the variation of the underlying asset in USD and the interest income received on foreign assets.

5/ Measured as the cost rate (in semiannual terms) multiplied by the average amount of international reserves in the period (in BRL).

6/ Profitability of reserves minus its carrying costs.

7/ The interest income received on foreign assets is ignored due to missing data.

8/ BCB's results as recognized in its financial statements.

9/ Average interest rate remunerating the liabilities of the central bank, in annualized terms.

10/ Semiannual variation of the BRL/USD exchange rate, based on end of the period values of the sale rate (sgs code: 1).

An understanding of the FX swap instrument is enough to drive home this point. In these contracts what is exchanged is the variation of the BRL/USD exchange for the interest rate differential between the domestic and the relevant foreign interest rate in a given period. Therefore, interventions with traditional FX swaps – the ones in which the central bank assumes the short position in exchange rate variation – are covered by the financial returns on the international reserves. It is easier to see this coverage in Table 5.5 where the financial results that derive from the international reserves next to the returns arising from a traditional FX swap are visualized together. One can see that the central bank has a capital gain ($+\Delta E$) on its international reserves when the BRL depreciates but have an equivalent loss with an FX swap contract ($-\Delta E$). At the same time, the

central bank must pay the effective domestic interest rate in some of its liabilities that were created to sterilize the accumulation of reserves (-i), but it is active on the local interest rate on the FX swap contract ($+i$). Finally, it receives the international interest rate in its foreign assets (i^*), but must pay the *cupom cambial* (q), a synthetic interest rate in USD that reflects the libor plus a country risk-premium, on its FX swaps contracts.

Table 5.5: Profitability of international reserves and FX swaps (central bank's balance sheet).

International reserves		FX Swaps	
Gains	**Losses**	**Gains**	**Losses**
$+\Delta E^a$	$-i$ (carrying costs)	$+i$	$-\Delta E$
$+i^*$			$-q$

a/ Unrealized retranslation gains.

Author's elaboration.

Therefore, as long as the central bank has enough foreign assets to cover the FX swaps operations, they will be fully hedged in an accounting sense. In any case, Mendes (2016) and Viana (2018) are right to point out that the financial expenses of the FX swaps are realized in the economy whereas the capital gains on the international reserves are not. The consequence is that the central bank will have to compensate for these expenses. However, one should also note that the financial results involved in the FX swaps interventions are completely settled in BRL. As we saw in section 5.3, in such circumstances one cannot apply the same constraints to a central bank as he or she would to a commercial bank. In particular, the concerns raised by Bignon et al. (2009) and Biondi (2011) about the utilization of unrealized profits in private entities should be relaxed since the central bank is not liquidity-constrained in its own currency.

Finally, one aspect that is surprisingly ignored by the literature critical to the law 11,803 is the role of the carrying costs of reserves. The carrying costs are measured by the BCB as the product of the stock of international reserves in the domestic currency multiplied by the average interest rate that remunerates its liabilities (the cost rate). As we can see in Table 5.4 above, they were positive in every semester from the beginning to the end of the period regulated by the law 11,803. Moreover, with the exception of the first semester of 2016, they always dominated the realized results and implied in a negative realized result in the foreign exchange operations of the BCB. Furthermore, the carrying costs tend to be procyclical, increasing together with the depreciation of the exchange rate. This procyclicality has two reasons: i) the cost rate (column k) tends to increase if the central bank adopts a contractionary policy stance, as was the case in 2015; and ii) the total stocks of international reserves, measured in BRL, also increase with the

depreciation of the BRL, even if the foreign exchange reserves are stable in USD. These effects, together with the expressive losses with FX swaps in 2015 generated substantial realized losses from the end of 2014 to the end of 2015.

This debate culminated with the law 13,820 that was approved in the first semester of 2019 and will reshape the accounting framework that governs the relationship between the BT and the BCB from the second semester of 2019 onwards. The new legislation addressed the main criticism to the law 11,830, i.e., that it allowed the implicit financing of the treasury by unrealized gains at the central bank, and determines that all positive results in the equalization operation will be transferred to a revaluation account created to hold these results. Therefore, there will be no more transfers of foreign exchange results to the BT.[30] In the case of foreign exchange-related losses, they will first consume the resources available at the revaluation account, then they will draw upon the capital of the central bank, and only when the capital of the central bank falls below a certain threshold (1.5% of assets of the BCB) the BT will cover up the losses. The rules governing the operational results of the BCB remained virtually the same. The new law also addressed the criticism that the previous framework was not sufficiently rigorous in determining the conditions in which the BT would recapitalize the BCB (Carvalho Jr., 2016; Mendes, 2016) and determined that the BT must automatically recapitalize the BCB whenever its equity falls below 0.25% the value of its total assets. Therefore, the law 13,820 introduced a modified version of the prudence principle by creating a revaluation account while pragmatically preserved the consolidation of all foreign exchange operations. Furthermore, it preserved the asymmetric distribution scheme between the BT and the BCB, crucial for the constitution of an adequate portfolio of bonds in the central bank. To fully understand the consequences of the new regulation, it is important to have an idea of how they would have been if the new regulation had been adopted in 2008. It is to simulate the developments under these different accounting frameworks that we turn next.

5.6.3 Simulation of different accounting frameworks

The objective of this subsection is to simulate how different accounting frameworks would have affected the operation of the BCB.[31] The simulations use real data from the BCB, and most of the raw data is also presented in Table 5.4. Furthermore, we only analyze the foreign exchange operations of the BCB. To the best of our knowledge, we are the first

[30] The only anticipated exception to this rule is in a situation of "severe" liquidity constraints affecting the BT. In such cases the Brazilian monetary council (CMN in the Portuguese acronym) can authorize the BT to use the resources inside the revaluation account.

[31] All of the simulations were implemented using Python. The codes used to run the simulations and all of the data presented in this paper are available at https://github.com/joaomacalos/bkr_accounting_2020.

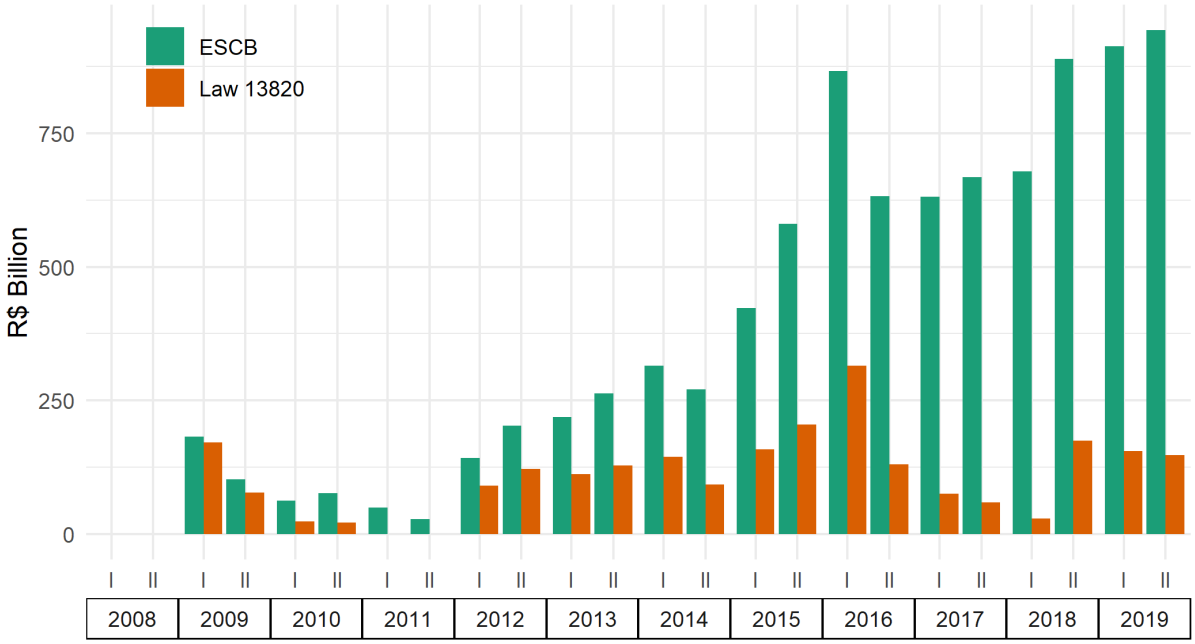
to run these simulations for the Brazilian economy,[32] following the approach of Schwarz et al. (2015) to evaluate the accounting framework of the ECB.

We start with the simulation of the revaluation accounts, which can be seen in Figure 5.7. For this comparison, it only makes sense to display the results for the ESCB' and the law 13,820' frameworks. As was argued above, in the ESCB framework all of the unrealized results of the BCB would have been transferred to the revaluation account while the realized results[33] are immediately would have been recognized in the income account. We can see that this would result in an inflated revaluation account at the BCB, holding more than 800 billion BRL at the end of the simulation. On the other hand, the law 13,820' framework would have led to a significantly smaller revaluation account, although still positive, at the end of the simulation. The reason is that the realized costs would be constantly drawing resources from the revaluation account. One can think that there is an uncovered interest rate parity logic behind this rule since there is a sort of compensation between the positive interest rate differential and the unrealized profits deriving from the depreciation of the BRL that more or less compensate each other.

[32] One note on the methodology: the developments of period t are added to a revaluation account or will trigger a recapitalization on the period $t+1$. For example, an unrealized profit in the first semester of 2010 is added to the revaluation account in the second semester of 2010. That is why the simulation series end in the second semester of 2019.

[33] The interest rate income of the BCB on its foreign assets – a component of the realized results – was only made available from 2011 onwards. We decided to ignore these values, assuming that it was equal to zero in the simulations. Therefore, the revaluation account and the losses that would have been covered under the ESCB framework are slightly overestimated. For the years with available information, the average interest rate received on foreign assets in each quarter was, in annual terms, equal to 1.1% and the accumulated interest rate gains of the BCB on its foreign exchange reserves was approximately equal to 95 billion BRL.

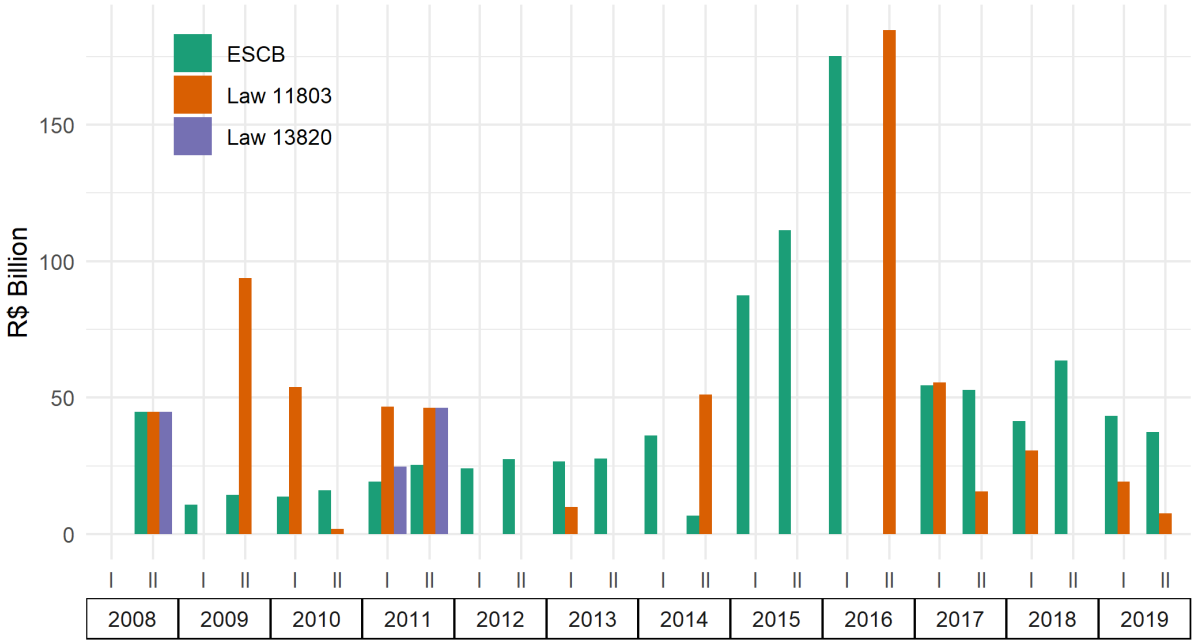
Figure 5.7: Simulation of revaluation accounts



Author's elaboration.

The second item we analyze is the losses that would have to be covered by the BT. These can be seen in Figure 5.8. In the ESCB framework, these would be the realized losses, while in the law 13,820 case it would be the losses if there were no more buffers available. We also display the results that were observed under the framework of the law 11,803 – where all losses were covered – for comparison. The first striking feature that we can see is that the ESCB framework, despite the size of the revaluation buffer, would be the framework generating the most frequent losses. The framework of the law 13,820, on the other hand, would trigger a loss coverage only three times in the period – all before the rise of the revaluation account from 2012 until 2015. Finally, we see that the law 11,803 framework implied that the BT often had to cover the losses of the BCB, although it did not generally coincide with the periods in which the ESCB framework would demand a loss coverage. For instance, the appreciation of the BRL in the first semester of 2016 led to a huge realized gain in the second semester of 2016 – as a consequence of the gains with FX swaps – and therefore no loss coverage under the ESCB framework. However, under the law 11,803 framework, this semester witnessed, in fact, the highest loss coverage of the period.

Figure 5.8: Simulation of losses covered by the Brazilian treasury



Author's elaboration.

Yet, one should wonder, from seeing Figure 5.8, how would the BCB get the required treasury bonds to compensate for the substantial realized expenses under the law 13,820 framework if it did not generate any losses that would have been covered by the BT. The answer is simple: the BT would have to replenish the government securities' portfolio at the BCB. To have an idea on the magnitudes,[34] we created a hypothetical account that represented the available bonds for monetary policy at the BCB. Its initial value was set to 160 billion BRL, approximately the same amount of free bonds at the BCB portfolio at the end of 2007.[35] Since all the realized results should, everything else equal, be compensated by an offsetting monetary policy operation, the realized losses of period t were discounted from the available bonds account in period $t+1$ while realized profits were added to it. Moreover, all of the losses covered by the BT were added to the available bonds account since those losses were covered by the issue of bonds. The result of this simulation is presented in Figure 5.9.[36] The ESCB framework is not displayed since there would be no need to replenish the portfolio of the BCB under this framework given the

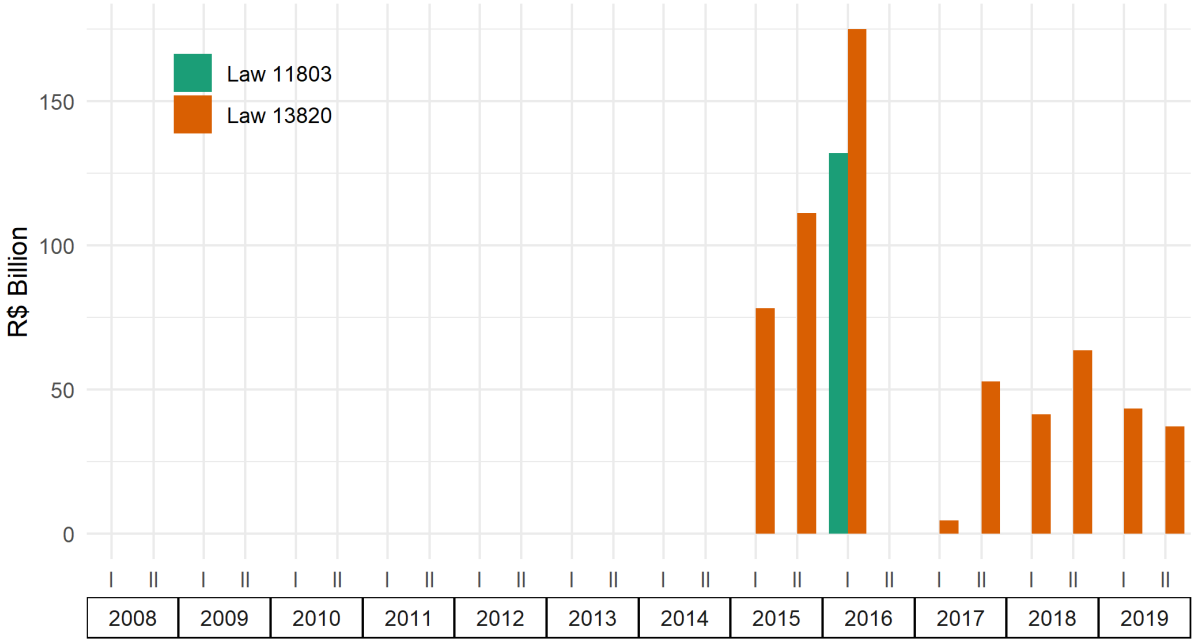
[34]Since we are only considering the foreign exchange results, there is not enough information to make a precise calculation on the minimum threshold of capital as being equal to 0.25% of the total assets – as defined by the law 13,820.

[35]One can find this information in the financial statements of the BCB.

[36]We also added the simulated values under the law 11,803 rule for comparison. As we can see, under this rule, and restricted to the foreign exchange operations and under the hypothesis outlined in the text, we would expect a further recapitalization of the BCB by the amount of 135 billion BRL by the first semester of 2016 to make the available bonds account equal to zero. In reality, the BT replenished the portfolio of the BCB only three times in the whole period, starting in the first semester of 2015 and finishing on the first semester of 2016. The securities transferred to the BCB amounted to 140 billion BRL, a value that is strikingly close to one estimated by our simulations.

frequency of realized losses under that framework. As we can see, if the law 13,820 was in place the BT would have to have recapitalized the BCB quite often, particularly after the significant losses registered in 2015.

Figure 5.9: Simulation of portfolio-led recapitalizations of the Brazilian Central Bank by the Brazilian treasury



Author's elaboration.

Finally, to conclude this subsection, it is important to reflect upon a point made by Stella (2005, p. 355) that the treasury might be less inclined to recapitalize the central bank in periods of fiscal distress. Even if there is an unconditional recapitalization scheme in place, he argues that the treasury might still increase the political pressure on the central bank to curb its losses in a period of fiscal crisis. Since the losses of the central bank under the ESCB framework closely follows the realized losses – that are procyclical and follow the depreciation of the currency –, such a framework would require a procyclical recapitalization of the central bank by the treasury – the highest realized losses were experienced in 2015, also the most severe year of the Brazilian crisis – together with an inflated revaluation buffer. One could expect that the government would question the rationale of the central bank's policies under these circumstances. On the other hand, the law 11,803 framework in which the transfers were regulated by the equalization operation that was in turn dominated by the unrealized results of the BCB presented a contrasting countercyclical behavior, feeding the BCB with bonds in tranquil times that backed the expansion of reverse repos in the rainy days of the BRL depreciation.[37]

[37]It is important to note that the scrutiny over the policies of the BCB, in particular the utilization of the FX swaps, increased in the period, together with the growing criticism over the law 11,803 framework.

The framework of the law 13,820 sits somewhere in between, sharing the characteristics of both frameworks. The consolidation of the realized with the unrealized foreign exchange operations implies that its revaluation account is frequently being depleted, which can trigger the transfer of bonds to the BCB following the appreciation of the BRL, as would have happened in 2011. However, the steady depreciation of the BRL between 2012 and 2016 implied that, if the law 13,820 had been implemented in the period, it would have led to a significant transfer of government securities to the central bank in 2015[38] to replenish its portfolio of free securities to back the expansion of reverse repos in the period, although the fact that these transfers would not have been generated by losses would perhaps spare the BCB of some criticism. The replacement of reserves repos by remunerated reserves at the central bank as the monetary policy instrument of the BCB would free its liquidity management operations from the availability of free securities in its portfolio and effectively circumvent this problem.

5.7 Lessons from the Brazilian experience

After the several crises in newly integrated economies at the end of the 1990s, a consensus emerged in the literature and among policymakers about the importance of the precautionary accumulation of international reserves to shield these economies from the instabilities of the global financial flows. However, one important collateral effect of this hoarding was the increase of the balance sheet of central banks in these economies. This expansion increased the volatility of the profits and losses of central banks as a consequence of the association between the high-volatility of many of these currencies and the fair value retranslation of their foreign assets to the domestic currency – the dominant accounting paradigm nowadays.

The first point we emphasize is that central banks are not commercial banks. They retain the issuance monopoly of the domestic currency and they cannot go bankrupt. Therefore, except for central banks indebted in foreign currencies, one should not speak about liquidity or solvency constraints in the same way as one would with commercial banks. As a consequence, the problems involved in the distribution of unrealized profits are different: they do not endanger the finances of the central bank, but they could lead to monetized financing of the treasury and hence to the expansion of interest-earning liabilities at the central bank. The only objective constraint that may arise at the central bank is the lack of adequate instruments to manage the liquidity in the economy and thereby keep the interest rate on target if the central bank is forbidden to issue its interest-earning liabilities and depends on the availability of government securities at the central bank's portfolio. Yet, persistent losses can threaten the credibility of the central bankers

[38] To be fair, even the law 11,803 entailed a recapitalization in 2015 given the magnitude of the depreciation between 2014 and 2015.

to achieve their monetary policy objectives. These issues place the legal and accounting framework in center stage, given its importance in the determination of the profits and losses of the central bank and on the regulation of the relationship between the treasury and the central bank.

If the plain IFRS framework is in place, all of the fair value retranslation is recognized in the income statement. Hence, this framework would not only translate the variability of the exchange rate to the results of the central bank but could also provide funding for the treasury that, if used, would demand offsetting operations from the central bank to keep the operational interest rate on target that in turn could depend on the availability of government securities at the central bank's portfolio. The ESCB framework, on the other hand, emphasizes the prudence principle and requires that all unrealized profits be transferred to a revaluation account. This system effectively eliminates the possibility of monetized financing, although it can lead to inflated revaluation buffers and procyclical recapitalizations of the central bank in NIEs. Therefore, even if it is often viewed as the best international practice, we agree with Archer and Moser-Boehm (2013) and Caruana (2013) when they emphasize that there is no one-size-fits-all accounting cookbook that should be adopted by every central bank.

The Brazilian experience is illustrative of many of these problems. Soon after the increase in the foreign assets at the central bank, it was clear that the existing IFRS-based accounting framework did not provide an adequate portfolio of government securities to the central bank to maintain its operational capability and that it would also increase the volatility of its results. It was to fix these problems that the law 11,803 was approved in 2008. This law created a new accounting framework with two important innovations: it allowed the treasury to issue and directly transfer securities to the central bank, either for covering central bank's losses or to replenish its portfolio; and it created the equalization account at the central bank that would record all of the expenses and incomes associated with the foreign exchange operations and would transfer them to the treasury, shielding the income statement of the central bank from its volatility. The consolidation of the realized with the unrealized foreign exchange results implied by the equalization account and its full transfer to the treasury enhanced the autonomy of the Brazilian Central Bank to implement its policies in two important ways: i) the correlation of the equalization losses with the appreciation of the BRL provided a countercyclical replenishment of the portfolio of government securities at the BC; and ii) it provided an important accounting hedge to the interventions of the Brazilian Central Bank with foreign exchange swaps – which were important to safeguard the financial stability of the economy. However, the equalization account also led to the distribution of unrealized profits to the government, triggering growing criticism about a possible backdoor channel of monetized financing.

This criticism was behind the approval of a new accounting framework – the law 13,820 – in 2019. The main innovation of the new framework is that it determines that all positive

results of the central bank with its foreign exchange operations must be transferred to a revaluation account at the central bank. Therefore, it effectively closed the backdoor channel of monetized financing while preserved the accounting hedge of countercyclical foreign exchange interventions with foreign exchange swaps. Since all the financial flows involved in the FX swaps are settled in the domestic currency, this consolidation cannot lead to a liquidity problem at the central bank.

Furthermore, our simulations indicate that, contrary to what would happen under the ESCB framework, the accounting framework of the law 13,820 would not lead to an inflated revaluation account due to the constant drainage of this account by the carrying costs of the international reserves. It would also minimize the recognition of higher realized losses in the income statement during turbulent times. However, the existence of the revaluation account would also weaken the countercyclical transfer of government securities to the central bank during tranquil times, which will probably result in more frequent transfer of securities to the central bank in the form of portfolio replenishments during turbulent times when realized losses are higher. Therefore, the law 13,820 is a hybrid between the ESCB framework and the law 11,803 framework that takes advantage of the main benefits of both frameworks while avoiding their main complications.

The lesson to be drawn from the Brazilian experience is that the accounting framework is not neutral: it can either enhance or impair the ability of the central bank to implement its monetary and exchange rate policies. Furthermore, what is adequate for a given country might not be as much for another. Therefore, even if the international experience provides important benchmarks and examples, the accounting framework of a central bank should be tailored to address the specific needs of each central bank.

Chapter 6

General conclusion

This thesis was centered on the relationship between the global liquidity cycles and the currencies of developing and emerging economies, as well as the exchange rate policies adopted by the Brazilian authorities. Given the structure of the thesis into four self-contained chapters, this general conclusion starts by enumerating the main contributions to the literature from each chapter and then concludes with a general assessment of the topics discussed by the thesis, emphasizing the policy implications that arise from it.

The thesis starts with a review chapter that presents the main strands of the post-Keynesian theories of exchange rate dynamics and interventions in emerging economies. The main novelty of chapter 2 is the integration of the microstructural dynamics of exchange-based markets into the cambist post-Keynesian approach. This interpretation is centered on the role of market makers. These agents provide intermediate liquidity to the markets and profit from the bid-ask spreads they charge. Therefore, they accept orders from final clients and move their spreads to keep their inventories balanced. Furthermore, we show that they hedge residual open positions into markets of different maturities. By doing so, they diffuse the price pressures through the whole spectrum of foreign exchange markets.

It follows that, even in exchange-based markets where prices are formed through limit-order books, the covered interest parity – measured by the interest and exchange rates available to the relevant market participants – should hold on average, preventing systematic arbitrage profits and disconnecting the spot exchange rate from the expected spot rate in the future. This interpretation also places market makers and their pricing decisions in center stage. Therefore, the key tenets of the post-Keynesian cambist interpretation is retained. A thorough empirical assessment of these theoretical claims requires detailed data from financial institutions and remains an avenue for future research. These insights are crucial to fully grasp the transmission mechanism that connects the domestic non-deliverable forwards auctioned by the Brazilian Central Bank and the full spectrum of the Brazilian foreign exchange markets.

The review chapter also lays the theoretical foundations that support the analyses developed in the three analytical chapters of the thesis. It provides a unified interpretation of the different structuralist post-Keynesian approaches, connecting the currency hierarchy school with the new developmentalist school. The unifying concept between these schools is the global liquidity cycles that drive capital flows and commodity prices. In this sense, the Dutch disease problem must be seen in its cyclical context. This analysis leads naturally to a Minskyan interpretation of exchange rate dynamics in DEEs. Finally, the last section of the chapter concludes that the scope of precautionary policies should be enlarged to include the targeting of real exchange rates consistent with balanced current account results, so as to better insulate the DEEs from the swings of the global liquidity cycle.

Chapter 3 of the thesis explores a key characteristic of the Minskyan cycles of exchange rates in DEEs: its asymmetrical nature. As emphasized by the literature on the topic, the ascending phases of the global liquidity cycle tend to be gradual and spread throughout many years, while the reversal of the global liquidity cycle is generally abrupt. The main contribution of chapter 3 is an empirical assessment of this behavior. We employed a novel panel data technique to explore whether there is evidence of an asymmetrical response of the "exchange-rate market pressure" index to the evolution of different variables associated with the global liquidity cycle in a group of 25 DEEs between 2004 and 2018, and we provide robust empirical evidence of such asymmetry. For example, we show that capital outflows from emerging markets were associated with a depreciation of the DEE's currencies that was about 77% larger than the association of capital inflows of the same magnitude associated with the appreciation of their currencies. Chapter 3 also presents a novel robustness test for outliers in panel data estimations that draws from machine-learning techniques that show that the main results are virtually unaffected by the exclusion or inclusion of various countries in the sample. A qualitative analysis of the different features within the group of DEEs remains an important avenue for future research. Another important avenue for future research is the formalization of this research agenda into stock-flow consistent models. The first step in this direction was the development of the *sfcr* R package that facilitates the conception and reproducibility of these models in an open software environment.[1]

In Chapter 4, I explore the domestic non-deliverable forwards (locally known as "FX swaps") policy of the Brazilian Central Bank. The main contribution of this chapter is a historical analysis of the DNDFs' policy implemented by the BCB from different angles. This chapter aims to answer three questions: why the BCB intervened with these instruments, how these interventions affected the markets, and the limitations and tradeoffs involved with these interventions. The key characteristic of these contracts is that they are settled in BRL. Therefore, the BCB was able to intervene in the foreign exchange mar-

[1] https://joaomacalos.github.io/sfcr/

kets without wasting dollar reserves. Official documents of the BCB and the interactions between its directors and the press were reviewed to understand the reasons behind these interventions. This analysis shows that the BCB targeted two objectives: strengthening hedging markets and offsetting excessive currency volatility. An analysis of a decade-long time series of the open positions of institutional investors in the DNDFs' market and the three main Brazilian FX derivatives as well as the spot position of commercial banks reveals that the counterparties of the BCB in the DNDF market did increase their net expositions in the remaining FX markets – as expected by the BCB.

To assess the effectiveness of the BCB's interventions in taming excessive BRL volatility, I focused on a group of interventions that offered "higher-than-usual" coupons – a sign of interventions aimed at taming excessive volatility. An event-like study was applied to evaluate the market developments around these interventions, revealing that a premium above the influence of global variables existed before the HC interventions and disappeared afterward, indicating that these interventions successfully brought the variation of the BRL back to its historical levels. Finally, an assessment of the costs and limitations of these policies concludes the chapter. It is shown that the DNDFs' were quite costly to the BCB in the years in which the BRL significantly depreciated (e.g., 2015 and 2020). These losses generated transactions between the BCB and its counterparties and led to an increase in the interest-bearing liabilities of the BCB and of the government. In contrast, the sale of international reserves would have decreased the central bank's interest-bearing liabilities. Therefore, there is a tradeoff in the utilization of these policies since the external policy space obtained by its utilization is compensated by a decrease in the internal policy space of the central bank.

Finally, chapter 5, the last analytical chapter, analyzed the relevance of the accounting legislation for monetary policy implementation. The unprecedented accumulation of international reserves in DEEs led to a structural modification of the balance sheets of their central banks. Since the 2000s, most of DEEs' central banks experience profits when their currencies depreciate and losses when their currencies appreciate. Furthermore, the size of these profits and losses increased with the size of central banks' balance sheets and led many authors to worry about backdoor monetary financing from the transfer of unrealized capital gains from the international reserves. Therefore, "prudential" accounting systems that accumulate the unrealized results into a buffer account are usually recommended as the best practice to DEEs. However, I show that an uncritical implementation of such systems in these economies would lead to inflated buffers.

The idiosyncratic Brazilian legislation that was approved in 2019 is presented as a potential alternative. On the one hand, it disallows any backdoor monetary financing by creating a revaluation buffer from capital gains. However, all the realized costs of the BCB's foreign exchange policies are discounted from these profits beforehand. Therefore, these profits can cover the carrying costs of the central bank with its international reserves

and the losses with DNDFs. Avoiding such structural losses is important to preserve the central bankers' credibility, increasing their policy space. To illustrate these issues, I simulate how the results of the central bank would have fared if the "prudential" accounting systems had been adopted or if the 2019's system had been adopted since 2008 and show that they would have allowed the hedging of all foreign exchange interventions of the central bank at the same time as it would have avoided the transfers of unrealized profits to the treasury. On the other hand, a "prudential" system would have led to inflated revaluation buffers and structural losses.

Overall, the main message that arises from this thesis is that developing and emerging economies operate from a subordinated position in the international monetary and financial system. If left to market forces alone, their currencies become overwhelmingly linked to the global liquidity cycles. When the global appetite for risk is high, the price of commodities rises, and capital starts to flow towards these economies. Their currencies appreciate. This process leads to a domestic credit boom and higher consumption rates while inflation rates are kept in check. However, industrial sectors that are not associated with natural resources will present signs of atrophy. Growing current account deficits capture this increasing fragility. When the tide turns and investors flee away from these countries, the economic impact is harsh. Exchange rates depreciate fast, and central banks are forced to adopt contractionary monetary policies to keep prices under control. The higher the current account deficit experienced before the reversal, the higher the adjustment required in the foreign exchange markets. In this situation, active exchange rate policies are crucial to avoid patrimonial crises and financial distress. Among these policies, domestic non-deliverable forwards are particularly useful since they allow the central bank to provide hedging without spending a dollar. Nonetheless, these policies cannot sustain a nominal level of the exchange rate that is inconsistent with the new scenario where external financing is scarce. Furthermore, the extensive use of these policies gives implicit insurance to speculators and can end up increasing the bets against the central bank. DNDFs can smooth the landing but cannot keep the plane flying. Therefore, active exchange rate policies during the ascendant phases of the global liquidity cycle are crucial. Targeting a real exchange rate level consistent with balanced current account results accumulates resources at the central bank to deal with capital flights and reduces the adjustment burden on the private demand for foreign currencies in the markets during the reversal of the cycle. At the same time, prudential capital controls can prevent the formation of speculative trends and carry-trade activity, helping to prevent the excessive appreciation of the currency.

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