48º ENCONTRO NACIONAL DE ECONOMIA (2020)
Área 7 - Economia Internacional

Up the stairs, down the elevator? The asymmetric response of emerging markets' currencies to the global liquidity cycle

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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 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 move up by the stairs and down by the elevator.

Keywords: Exchange rate, financialization; liquidity cycle; developing economies.

Resumo:

Este artigo avalia se há evidências de uma relação assimétrica entre o ciclo de liquidez global e as moedas das economias emergentes e em desenvolvimento (DEEs), um princípio central da interpretação de minskyana do comportamento da taxa de câmbio nessas economias e da literatura da "financeirização das economias emergentes". Utilizamos uma nova técnica de modelo de painel que incorpora componentes assimétricos às regressões de efeitos fixos para verificar se há evidências dessa assimetria. Nossos resultados sugerem que os fluxos de capital, os preços das commodities e o VIX têm uma relação mais importante com as moedas das DEEs durante a retração do ciclo de liquidez global do que durante a fase expansionista. Em outras palavras, nossos resultados sugerem que as moedas dos DEEs sobem pelas escadas e descem pelo elevador.

Palavras-chave: taxa de câmbio, financeirização; ciclo de liquidez; economias em desenvolvimento.

JEL: F31; F32; G15.

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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 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 this liberalization (Bonizzi, 2013; De Conti et al., 2013; Kaltenbrunner, 2015a; Ramos, 2019). 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., 2013; 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 the second section, we review the currency hierarchy literature and relate it with the GLC, presenting descriptive statistics that contextualize the paper. In the third section, we discuss the asymmetry between the ascendant and descendant phases of the GLC and how they relate to the currencies of DEEs. In the fourth section, we present the data and the methodology adopted in this work. The results are presented in the fifth section. Finally, the sixth section concludes the paper with our final remarks.

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, Prates, and Plihon 2014; Kaltenbrunner 2015; Ramos 2016, among others).

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, Prates, and Plihon (2014) argue that different currencies enjoy different degrees of liquidity[3] 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, 2013, 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., 2013; Guttmann, 2016).

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. (2013), 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[4]. These operations trigger financial flows that appreciate the currencies of DEEs, which further reinforces the profitability of these speculative operations.

[3] For the 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, international liquidity should be understood as the capacity of an asset to be transformed quickly and without losses into a means of payment that is accepted internationally, i.e., into the currencies in the top of the hierarchy.

[4] 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).

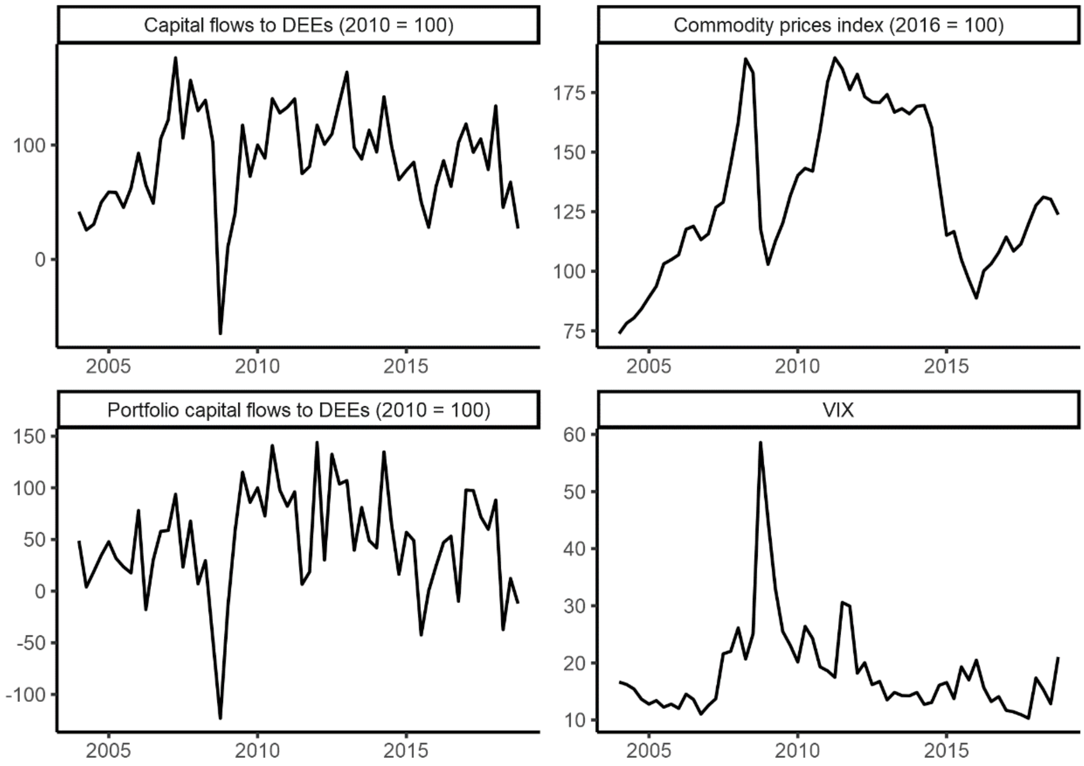
However, instead of being driven by a genuine preference of global investors for DEEs, most of these financial flows are determined by the profitability constraints imposed by the low rates of return in the central economies (Bonizzi, 2017). Hence, even when international investors allocate their investments 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, 2015b). 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.

2.1. Stylized facts

Figure 1 presents the four different indicators that are used in our empirical analysis[5] 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 1. In its upper-right part is displayed the "all commodities" prices index estimated by the IMF. In the bottom-left of the Figure is the total net portfolio debt inflows to the selected group of DEEs. Finally, the VIX[6] – a standard indicator of global liquidity preference – is in the bottom-right part of the Figure. 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.

[5] These variables described in the section 3 of this work and in the appendix.
[6] "Chicago Board Options Exchange Volatility Index."

Figure 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 2[7]. Figure 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 the Figure 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.

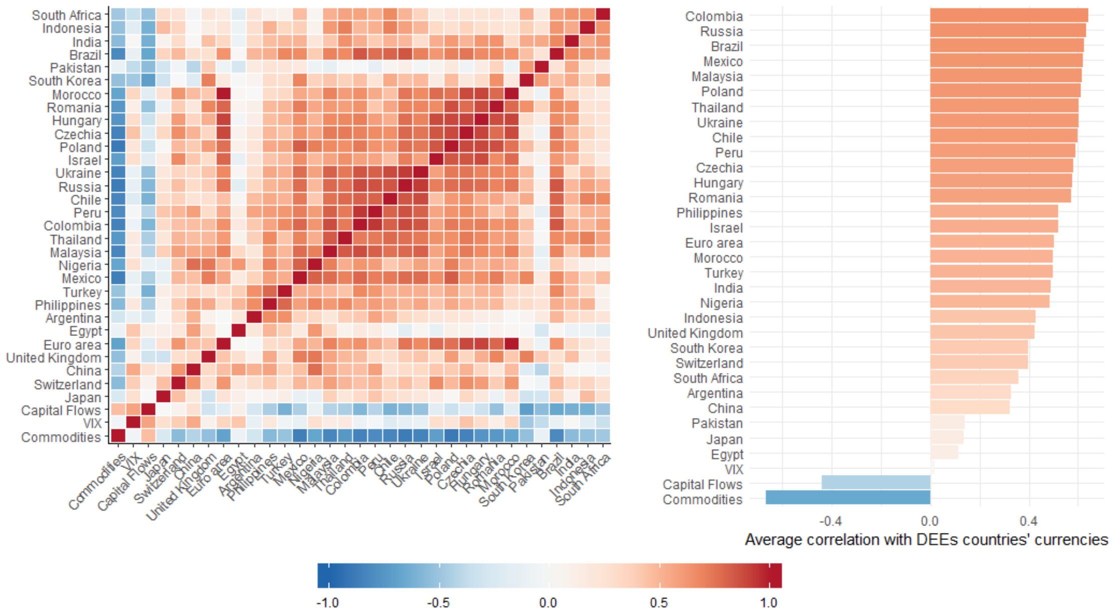
Since we measure the exchange rates as the price in dollars of one unit of the local currency, the appreciation of these currencies is captured by a higher value of the respective exchange rate. As a consequence, we chose to measure the series of capital flows to DEEs and of the commodity price index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

[7] The correlation matrix is calculated using variables in annual frequency. The criteria used for selecting the group of DEEs is detailed in the next section.

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 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[8] 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 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.

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

Cross-border flows play a vital role in the cycles outlined in the previous section 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

[8] 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.

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., 2013; De Paula and Alves, 2000; Dymski, 1999; Kaltenbrunner, 2015a; Kregel, 2001; Palma, 1998; Ramos, 2019).

Despite the relevance of this point, few empirical studies investigated this asymmetric behavior in detail[9]. Among them, the most important are Aizenman et al. (2012) and Hossfeld and Pramor (2018). Aizenman et al. (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

[9] Most of the related empirical literature investigates extreme exchange rate movements and currency crashes (e.g. Eichengreen et al., 1996; Goldberg and Krogstrup, 2019; Gonzalez, 2007; Heinz and Rusinova, 2015; Zeolla and Bastourre, 2017).

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.

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[10]. 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 sources of the data is presented in appendix B.

The estimated models have the following structure:

$$EMP_{i,t} = \alpha_i + \beta \mathrm{DV}_{\mathrm{i,t-1}} + \gamma^{+} Z^{+} GLC_{i,t} + \gamma^{-} Z^{-} GLC_{i,t} + \epsilon_t \qquad (6)$$

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 A. 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 four 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

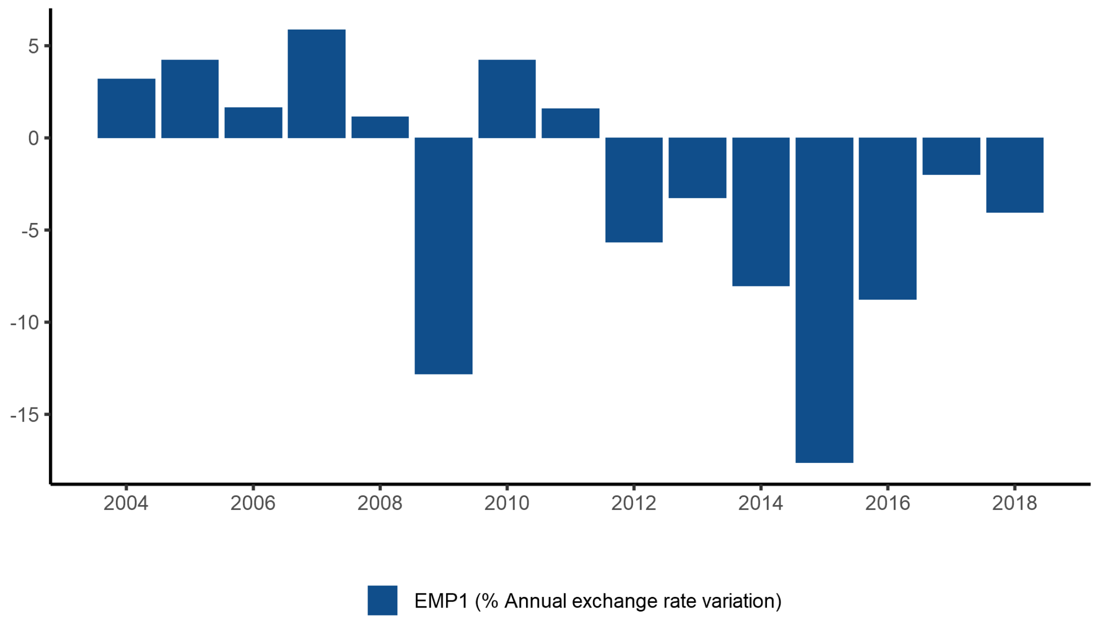
[10] The 25 countries included in the main sample are: Argentina, Brazil, Chile, Colombia, Czechia, Egypt, Hungary, India, Indonesia, Israel, South Korea, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey and Ukraine.

– that considers the log-variation of the exchange rates alone – in the body of the paper[11]. This definition has the advantage of its straightforward economic interpretation:

$$EMP1_{i,t} = 100 * \Delta \ln(E_{i,t}) \tag{7}$$

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[12]. 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[13].

Figure 3: EMP1 index (average values between the 25 countries included in the sample, 2004-2018)



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

[11] The pros and cons of different EMP definitions are presented in appendix C, together with the presentation of the three alternative definitions. The alternative definitions broaden the concept of exchange rate market pressure but are more difficult to interpret.

[12] A comparison between Figure 3 and Figure C.2 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 its currency prior to the 2008 crisis. Furthermore, an analysis of the indices reveals that the average DEE virtually refused to use its international reserves during the 2008 crisis.

[13] 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 didn't bounce back to pre-2015 levels.

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[14] 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 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 et al., 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.

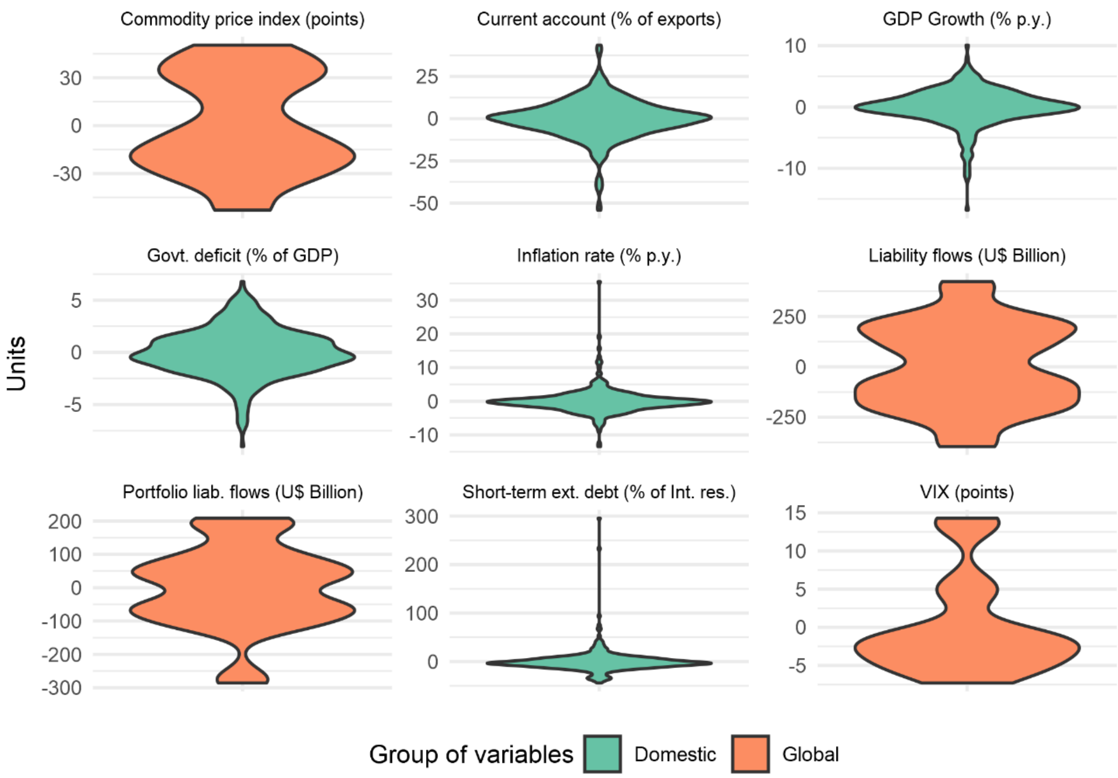
The third GLC variable included is the liability' financial flows (*flows*) to DEEs. This variable is the sum of the liability' portfolio, direct investment flows, and other investment flows to each DEE in the sample, and its utilization is standard in the literature (Biancareli, 2009; Borio, 2019; De Conti et al., 2013; 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. 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[15]. 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.

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

[15] Blanchard et al. (2017) adopted a similar methodology.

Figure 4 displays the distribution of the regressors (already centered around their country-level means[16].) 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 4 help interpret the regression coefficients in the next section. It is interesting to note that the domestic control variables, depicted in green in Figure 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 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 4: Violin plot of explanatory variables, centered around their country-level means



Note: The distribution of the VIX and commodity price indices are centered around their average value.

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

5. Econometric estimations

The first four columns of Table 1 present the results of the symmetric regressions[17]. 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 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.

[17] 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 1: Panel regressions, EMP1 as the dependent variable

	Symmetric				Asymmetric			
growth	0.7627***	0.7697***	0.8715***	0.8522***	0.4301***	0.3750***	0.5167***	0.5177***
	(0.1259)	(0.1398)	(0.1516)	(0.1160)	(0.1089)	(0.1058)	(0.1198)	(0.0914)
cpi	0.1295	0.1507	0.1876	0.1346	0.0026	0.0174	0.0726	0.0009
	(0.1326)	(0.1303)	(0.1354)	(0.1227)	(0.1215)	(0.1114)	(0.1172)	(0.1118)
edebt_res	-0.0250	-0.0222	-0.0174	-0.0210	-0.0401	-0.0396	-0.0337	-0.0370
	(0.0710)	(0.0721)	(0.0712)	(0.0701)	(0.0677)	(0.0681)	(0.0669)	(0.0661)
cabex	0.4454***	0.4603***	0.4581***	0.4485***	0.3685***	0.3766***	0.3741***	0.3692***
	(0.0900)	(0.0920)	(0.0901)	(0.0892)	(0.0864)	(0.0816)	(0.0831)	(0.0817)
def	0.6907***	0.7124***	0.7511***	0.6825***	0.6793***	0.7335***	0.7260***	0.7046***
	(0.2525)	(0.2632)	(0.2668)	(0.2638)	(0.2301)	(0.2293)	(0.2410)	(0.2340)
vix	-0.0437							
	(0.0472)							
comm		0.0329***						
		(0.0127)						
flows			0.0098***					
			(0.0017)					
port_flows				0.0080**				
				(0.0037)				
vix_zpos					-0.2074***			
					(0.0679)			
vix_zneg					-0.0732			
					(0.0464)			
comm_zpos						0.0205*		
						(0.0123)		
comm_zneg						-0.0865***		
						(0.0156)		
flows_zpos							0.0091***	
							(0.0014)	
flows_zneg							-0.0161***	
							(0.0024)	
port_flows_zpos								0.0050
								(0.0035)
port_flows_zneg								-0.0138***
								(0.0037)
R^2	0.2568	0.2657	0.2958	0.2642	0.3081	0.3438	0.3616	0.3269
Adj. R^2	0.1920	0.2017	0.2344	0.2001	0.2455	0.2845	0.3039	0.2661
Num. obs.	375	375	375	375	375	375	375	375

***p < 0.01, **p < 0.05, *p < 0.1
Robust standard errors in parentheses.

The last four columns present the results of the asymmetric regressions. However, before analyzing the asymmetric coefficients, we must first test whether they are statistically different from each other. As can be seen in Appendix D, Table D.1, there is enough evidence to reject the null hypothesis of no asymmetric effect for all of the GLC variables.

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 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.

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 the EMP2, EMP3, and EMP4 as the dependent variable, presented in Appendix E, are roughly similar to the ones shown in Table 1. The main difference is with the coefficients associated with the commodity index in the regressions with EMP3 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 EMP4 is significant and has the expected sign as in the main regression, but it is not significant to different country subsamples.

5.1.1. 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[18]. If this is the case, the results might be biased by the presence of outliers.

The results of these tests for the models estimated using the EMP1 index as the dependent variable are presented in Table 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 in the previous subsection. We report four statistics: the minimum, the maximum, and the

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

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 2: Robustness check 1: sensitivity to different country subsamples. EMP1 as the dependent variable.

	24 countries				23 countries				20 countries			
	n = 25				n = 300				n = 1000			
Regressor	min	max	mean	signif. (%)	min	max	mean	signif. (%)	min	max	mean	signif. (%)
comm_zneg	-0.093	-0.080	-0.086	100	-0.100	-0.073	-0.086	100	-0.111	-0.063	-0.086	100
comm_zpos	0.013	0.027	0.021	8	0.010	0.032	0.021	12	0.005	0.040	0.021	19
flows_zneg	-0.017	-0.015	-0.016	100	-0.018	-0.014	-0.016	100	-0.019	-0.012	-0.016	100
flows_zpos	0.009	0.010	0.009	100	0.008	0.010	0.009	100	0.007	0.011	0.009	100
port_flows_zneg	-0.015	-0.012	-0.014	100	-0.016	-0.010	-0.014	100	-0.020	-0.008	-0.014	100
port_flows_zpos	0.003	0.006	0.005	0	0.002	0.008	0.005	5	-0.001	0.010	0.005	10
vix_zneg	-0.100	-0.051	-0.073	4	-0.116	-0.032	-0.072	10	-0.144	-0.002	-0.070	13
vix_zpos	-0.254	-0.181	-0.207	100	-0.272	-0.147	-0.207	100	-0.309	-0.106	-0.205	94
cabex	0.323	0.419	0.372	100	0.268	0.471	0.373	100	0.219	0.545	0.376	100
cpi	-0.094	0.125	0.023	0	-0.157	0.171	0.024	0	-0.211	0.271	0.023	1
def	0.531	0.849	0.710	100	0.424	0.927	0.709	99	0.242	1.082	0.704	87
edebt_res	-0.084	0.042	-0.037	4	-0.097	0.048	-0.036	7	-0.117	0.061	-0.033	14
growth	0.260	0.562	0.455	100	0.196	0.601	0.449	99	0.098	0.668	0.434	96

Looking at Table 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[19].

Finally, to account for the Leamer (1983) critique, we tested the sensitiveness of our results to all possible combinations of domestic control variables[20], including the case with no domestic control variable. These tests are presented in Table 3. All the GLC

[19] 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, while 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 these countries have a disproportionate influence in the overall result.

[20] Including the case in which no domestic control was included, there are 31 possible combinations of variables for each GLC indicator. Each of the domestic control variables appears 15 times in each of these 31 combinations. Therefore, each domestic control variable appears 60 times when we aggregate the models estimated with the 4 GLC variables.

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 1. The other significant control variables on the main model are not robust to different specifications.

Table 3: Robustness check 2: sensitivity to different combinations of control variables. EMP1 as the dependent variable.

Regressor	min	max	mean	total appearances	significant (%)
comm_zneg	-0.094	-0.085	-0.090	31	100
comm_zpos	0.000	0.024	0.012	31	0
flows_zneg	-0.019	-0.016	-0.017	31	100
flows_zpos	0.008	0.010	0.008	31	100
port_flows_zneg	-0.017	-0.012	-0.015	31	100
port_flows_zpos	0.002	0.007	0.004	31	0
vix_zneg	-0.100	-0.035	-0.071	31	3
vix_zpos	-0.350	-0.194	-0.283	31	100
cabex	0.313	0.391	0.343	60	100
cpi	-0.223	0.075	-0.099	60	3
def	-0.183	0.767	0.219	60	28
edebt_res	-0.062	-0.034	-0.051	60	0
growth	0.027	0.553	0.243	60	25

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 the expansionist phase of the GLC. 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 speculative financial flows with measures to defend the external competitiveness of these economies might also be needed.

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