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International reserves and gross capital flows dynamics ☆

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ABSTRACT

This paper explores the role of international reserves as a stabilizer of international capital flows, in particular during periods of global financial stress. In contrast with previous contributions, aimed at explaining net capital flows, we focus on the behavior of gross capital flows. We analyze an extensive cross-country quarterly database – 63 countries, 1991–2010 – using standard panel regressions. We document significant heterogeneity in the response of resident investors to financial stress and relate it to a previously undocumented channel through which reserves act as a buffer during financial stress. A robust result of the analysis is that international reserves facilitate financial disinvestment overseas by residents – a fall in capital outflows. This partially offsets the drop in foreign capital inflows observed in such periods. For the whole sample, we also find that larger stocks of international reserves are linked to higher gross inflows and lower gross outflows. These results, which challenge current approaches to measuring reserve adequacy, call for refining such tools to better account for the role of resident investors.

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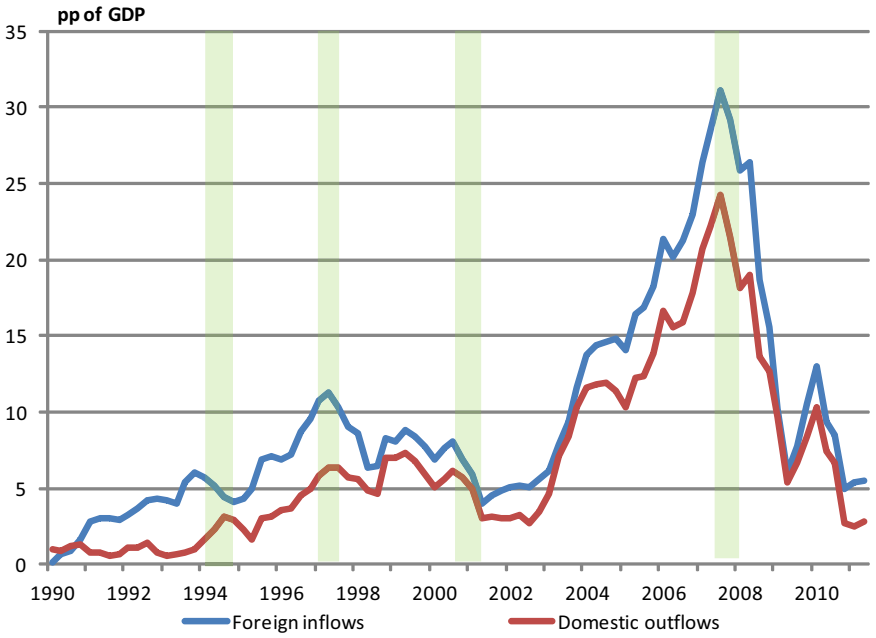


Graph 1. Gross capital flows in emerging economies.
Note: Average of gross capital flows, as % of GDP, for emerging economies – as classified in the Appendix. "Foreign inflows" are investments by foreigners, "Domestic outflows" are investments overseas by residents. Quarters of financial stress are dashed (1Q95, 3Q984Q01, 4Q08).

1. Introduction

In recent decades, the world economy has experienced a process of financial integration, with large increases in cross-border capital flows in both emerging and developed economies. The process has been far from smooth. As shown in Graph 1, where episodes of global financial stress (as defined in section 2) are depicted with a green shadowed area, cross-border capital flows have been increasing, grinding abruptly to a halt during the 1995–1996, 1998–1999 and 2001–2002 episodes of turmoil. Each time, they resumed soon afterward, reaching their peak at the onset of the 2008 global economic crisis. After their sharp collapse, financial flows are recovering again.[1] The picture is one of waves of increasing integration followed by episodes of sudden reductions in cross-border flows.[2]

While countries, in particular emerging economies, benefit from access to foreign savings, they can also be severely affected by episodes of disruption in cross-border capital flows. In fact, strong capital inflows can lead to exchange rate misalignments, foster credit booms and currency mismatches, and are subject to sudden stops. These can, in turn, trigger strong exchange rate depreciations, banking crises (Jeanne, 2010) and have long-lasting effects on GDP growth.[3]

Against this background, the challenge for policy makers lies in reaping the benefits of financial integration while managing these risks. Episodes of high capital flows to emerging economies have been managed with different tools. Macro-prudential policies and capital controls have sometimes been used during the upswing to prevent credit booms and financial instability. Even more often, in particular in the past decade, foreign reserve accumulation by Central Banks has been used to prevent

[1] Bussiere et al. (2015) show that as reserve has reached the per-crisis level, the speed of accumulation has slowed down.
[2] A similar picture emerges from Broner et al. (2013) and Forbes and Warnock (2012).
[3] Bordo et al. (2010) use early 20th century data to show that sudden stops can have lasting effects on GDP growth.

excessive exchange rate misalignments and build up buffers against eventual sudden stops Ghosh et al. (2012).[4]

Indeed, after the recent crisis, international reserve holdings have skyrocketed again in emerging economies. They exceeded 10 trillion dollars in 2011, well above the 7.5 trillion dollars at the onset of the crisis. Emerging economies' international reserves have climbed from 5 trillion dollars before the crisis to close to 6 trillion dollars. According to Jeanne and Rancière (2011), leaving aside China, reserve accumulation in emerging economies might be explained by precautionary motives. Financial integration in the last decades and the large shift in the international financial intermediation in the aftermath of the crisis can also make emerging economies more sensitive to financial shocks (Shin and Turner, 2015). This may call for a larger stock of reserves.

There is a growing consensus among policy makers that holding large stocks of foreign reserves pays off.[5] However, hard evidence supporting that view is scant, and there is mounting evidence that this policy might impose significant externalities and have major costs for the world economy (IMF, 2010). With this paper we aim to provide additional elements to evaluate the effects of reserve accumulation. We do so by assessing the effect of international reserve holdings by Central Banks on the behavior of cross-border investors, either foreign or domestic, through the analysis of gross capital inflows and outflows during periods of systemic financial stress.[6] Our approach goes beyond most of the empirical literature on the issue, which has focused mostly on the impact of reserves on either foreign flows or net capital flows.[7] By placing our focus also on resident investors, we follow a recent strand of literature that has suggested that international reserves are held at least partly to prevent and mitigate domestic capital flight. Along these lines, Obstfeld et al. (2010) show that international reserves depend on the economy's monetary aggregate (M2), which, they argue, can be seen as a proxy of the resources that residents can invest overseas.[8] Similarly, Jeanne and Rancière (2011) suggest that considering the level of M2 helps rationalize high levels of foreign reserves.

The literature using net flows has found contradictory evidence regarding the ability of international reserves to lower substantially the probability of experiencing sudden stops. According to Calvo (2007), sudden stops of capitals are best prevented by orthodox domestic policies and limited balance-sheet vulnerabilities, with international reserves playing an indirect role. Edwards (2007) argues that international reserves play a minor role in avoiding sudden stops. Calvo et al. (2008) suggest that international reserve holdings could both prevent a sudden stop by mitigating exchange rate depreciation and act as a buffer in the event of experiencing such a stop. Along the same lines, IMF (2006) emphasizes that international reserves are a relevant tool for self-insuring against external shocks. In contrast, García and Soto (2004) find a strong negative relationship between the level of international reserves and the probability of sudden stops.

Using net flows, however, can be misleading. Consider a sudden stop episode – a sharp reduction in net financial flows – and the consequent increase in financing needs. Does it reflect a reduction in overseas investment or an increase in investment overseas by residents? Along these lines, a few recent papers show that the underlying drivers of net financial flows are better understood if the data are divided into gross foreign inflows (i.e. financial investment in the country by non-residents) and gross

[4] Durdu et al. (2009) presents a general equilibrium model of reserve accumulation. It rationalizes the buildup of large foreign reserves as a precautionary behavior in an environment where credit constraints can lead to sudden capital stops. Caballero and Panageas (2008) compare self-insurance with active liability management and show that the latter can provide significant gains.

[5] IMF (2011) analyzes the level of reserves worldwide using a variety of reserve adequacy indicators. According to their preferred metric most countries hold an excessive amount of foreign reserves.

[6] A related strand of the literature, instead of focusing on the benefits of reserve accumulation, studies its determinants. For instance, Bastourre et al. (2009), using GMM techniques in a panel of emerging countries, find a U-shaped relationship between reserves and development level. They also find that countries with flexible exchange rate regimes have higher ratios of reserves to GDP. Chinn and Ito (2006) fail to find a significant relation between international reserves and an economy's degree of financial openness. Broto et al. (2011) shows that a larger stock of reserves reduces the volatility of FDI net flows.

[7] For instance, Obstfeld (2011) argues that international reserves are held to prevent foreign capital flight and, thus, relate to the countries' international liabilities.

[8] See also Frankel and Saravelos (2010) or Rose and Spiegel (2012) for empirical models focused on the reserve coverage to domestic monetary aggregates.

domestic outflows (i.e. financial investment abroad by residents). Rothenberg and Warnock (2011) show that many sudden stop episodes were indeed episodes of resident capital flight and that only a fraction were driven by a contraction of gross foreign inflows. In turn, Forbes and Warnock (2012) show that global factors are important determinants of both resident and foreign sudden stop episodes and that, although domestic macroeconomic characteristics hardly matter, changes in domestic economic growth influence episodes of foreign capital flight. Also closely related to our paper, Broner et al. (2013) and Cowan et al. (2007) argue that a key difference between developed and emerging economies during financial stress lies in the behavior of gross domestic outflows. According to Broner et al. (2013), who study the behavior of gross flows along the business cycle, during crises, foreign investors flee while domestic investors tend to retrench.[9]

We follow this "gross approach" to study the impact of international reserve accumulation on the behavior of gross capital flows, focusing on periods of global stress, and taking into account both the occurrence of the stress and its intensity. We build an extensive quarterly database on gross capital flows in which we distinguish the behavior of foreign investors in the economy from that of the economy's resident investors abroad. By looking separately at the domestic and foreign components of capital flows we address the following questions. Do international reserves play a catalytic role vis-à-vis foreign investors? Do they affect the behavior of gross domestic outflows? In light of the literature we perform the analysis measuring reserves in terms of both international financial liabilities, to proxy for the resources that non-residents can pull out of the country and, a narrow monetary aggregate (M2), to proxy for the resources which residents can pull out of the country.

Our main results suggest that the level of international reserves significantly influences the behavior of gross domestic outflows when financial stress increases. The evidence for the behavior of gross foreign inflows is less clear. During financial stress, countries with more international reserves experience larger drops in gross domestic outflows. International reserves make residents more willing to invest savings domestically and repatriate capitals invested overseas, mitigating the lack of foreign financing. According to our estimates, when financial stress is severe, outflows contract 1.5 pp of GDP more for countries with a ratio of reserves to M2 one standard deviation above the average.[10] Capital inflows, on the contrary, drop during the periods of stress, albeit under certain specifications, larger holdings of reserves mitigate the reduction. The empirical analysis also uncovers that the stock of reserves also matters outside these periods: gross inflows are larger and gross outflows lower the higher the stock of reserves. This implies, ceteris paribus, that net flows are larger, too.

The findings in this paper are relevant for at least two reasons. First, we highlight a previously undocumented benefit of holding reserves – the buffering impact of reserves in times of financial stress through their effect on resident investors.The stabilizing effect of reserves on the reaction of resident investors underscores potentially strong complementarities between the Central Bank's solidity and domestic investors' behavior. Candidate explanations for this complementarity are numerous. It could be that residents are more willing to repatriate assets when they are confident about the strength of their currency or about the ability of the authorities to manage financial instability without resorting to financial repression (Reinhart and Sbraccia, 2011). In fact, Obstfeld et al. (2010) argue that one important reason for accumulating reserves is to protect the domestic credit markets. From that perspective, the complementarity between residents and central bank reserves operates through the banking system balance sheet. Similarly, Reinhart and Tashiro (2013) recognize that reserves play a role in mitigating the risks of bank runs. For all these potential reasons, the relation between reserve accumulation and resident investors, that we uncover, should be taken into consideration in the design of any financial safety net aimed at limiting countries' incentives to accumulate reserves.

Second, the exercise provides new insights to the growing literature on the dynamic behavior of gross capital flows. In particular, the robust link we find between the level of reserves and the behavior of domestic outflows in periods of financial stress helps reconcile the reduction of external exposure of domestic investors in such episodes, documented in Broner et al. (2013), and the

[9] Broner et al. (2013) further show that the various capital flow components respond to crises very differently.

[10] As comparison points, we choose the average and one standard deviation above the average. The effect depends also on the intensity of financial stress. We choose an EMBI value of 1000 bps, and refer to it as a "severe financial stress".

recurrent domestic capital flight documented by Rothenberg and Warnock (2011) and Forbes and Warnock (2012).[11]

The rest of the paper is structured as follows. Section 2 describes the data. Section 3 provides preliminary evidence on the link between the behavior of gross flows and the level of reserves during periods of financial stress. Section 4 presents the econometric exercise and discusses our main results and robustness checks. Finally, section 5 concludes.

2. Data

We construct a database comprising 63 countries for the period 1991–2010. We select countries according to data availability, and constrained by our interest in using quarterly data.[12] Given that some relevant developments may last few quarters or that their impact is felt in quarters of different years we use quarterly data. Our final sample, detailed in Annex I, contains 44 emerging economies and 19 developed countries.[13]

Data on financial flows, as reported in Balance of Payment data, come from the *International Financial Statistics* of the *International Monetary Fund* (IFS). This source allows for disaggregation between financial inflows by foreigners, investments and disinvestments into the receiving economy, what we call *gross foreign inflows (GFI),* and financial outflows by residents, investments and disinvestments from the economy to overseas, defined here as *gross domestic outflows (GDO)*. Further disaggregation by instruments allows disentangling gross flows as foreign direct Investment (FDI) flows, portfolio flows and other investment flows.

Using this information, we construct the following aggregates in GDP terms. First, we define a measure of total financial investments by non-residents in the reporting economy (*GFI*, gross foreign inflows), which includes all three categories: FDI, portfolio inflows and other inflows. Second, we define an analogous measure of total financial investments by residents in the reporting economy overseas (*GDO*, gross domestic outflows), excluding central banks' purchases and sales of international reserves. Using these two aggregates we construct a measure of net capital flows, $NF = GFI - GDO$.[14] Finally, using the available disaggregation by types of flows, we construct measures of short-term capital flows (hot flows). Thus, we define *short-term gross foreign inflows*, *GFIST*, by adding up portfolio and other investment flows by non-residents in the reporting economy; and *short-term gross domestic outflows*, *GDOST*, using analogous information regarding residents' activity. Chart A1 in the appendix depicts the evolution of gross flows, and breaks them down between FDI and short-term flows. The latter are more volatile and increased more before the global financial crisis. Interestingly, while domestic short-term outflows are smaller in absolute terms, they have more weight in total domestic outflows than short inflows have in total foreign inflows.

For all of these variables, measured relative to GDP, we construct a four-quarter standardized cumulative version,

$$\hat{x}_{it} = \frac{\sum_{t=-3}^{0} x_{it}}{\sigma_{x_i}} \quad where$$

$$x_{it} = \{GFI/GDP, GDO/GDP, NF/GDP, GFIST/GDP, GDOST/GDP\}$$

[11] While our approach is similar to Broner et al. (2013), there are significant differences with Rothenberg and Warnock (2011). Rothenberg and Warnock (2011) use contractions in monthly international reserves to classify episodes as either capital flight or true sudden stops, depending on whether the change in reserves is driven by gross domestic outflows or gross foreign inflows.

[12] For instance, the large drop in capital flows in the last quarter of 2008 occurred after several quarters of large inflows. Thus, using annual data would hide this sharp contraction.

[13] We dropped financial-center countries (Ireland, Iceland, Luxembourg and Hong Kong) to avoid that their high and volatile flows drive the results.

[14] *NF* does not match the current account, which also includes errors and omissions and exceptional financing items.

Smoothing the series using a cumulative measure has two important advantages. First, it reduces the importance of dating exactly the quarter in which the episode of global financial stress unfolds. Second, it minimizes the importance of country-specific idiosyncratic events. However, it also entails a cost as it washes out the impact of the shock. Additionally, to reduce the impact on the estimation of the most volatile countries, we follow Broner et al. (2013) and standardize the series by dividing them with their corresponding standard deviation.

The final component of the database is the stock of reserves, which also comes from IFS. In order to assess the level of reserves the choice of the variable relative to which reserves are measured is fundamental. There is an ample literature on reserve adequacy, which can be used as a guide for the choice. One of the most popular adequacy rules is the Guidotti–Greenspan rule, according to which reserves should cover short-term external liabilities (maturing in less than one year). Other rules look at reserves as a fraction of foreign currency liabilities, short-term external debt, imports or monetary aggregates. There is no best measure, as different measures provide different insights.[15]

Given our focus on the distinct behavior of resident and foreign investors, we look at the level of reserves relative to two measures. First, we define a measure of the total resources that foreigners can pull out of the country, foreign liabilities, as collected by the IMF's International Investment Position data. Additionally, we look at a the level of reserves relative to the domestic monetary aggregate M2, which proxies the resources which residents can invest overseas, and takes into account the risk of experiencing a capital flight from residents (Obstfeld et al., 2010). Hence, we define the following variables:

$$RX_{it} = R_{it}/X_{it} \quad where \quad X_{it} = \{IL_{it}, M2_{it}\}$$

where R_{it} stands for international reserves, IL_{it} represents the international liabilities of the country and $M2_{it}\}$ stand for the country's M2 monetary aggregate. Then, RIL_{it} measures the level of reserves relative to potential outflows from non-residents. In turn, $RM2_{it}$ measures the level of reserves relative to potential outflows from residents. Chart A2 in the appendix depicts the histogram for each ratio, for emerging economies. Both distributions have similar skewness to the right. A relevant feature of our dataset on international reserves is the low density of the right tail. Only 5% of our observations for the coverage ratio, measured relative to M2, are above 80% coverage. This feature of the data will be important later, when discussing non-linearities.

The correlation between these two measures of reserves is relatively low, suggesting that, as detailed below, *RILF* and *RM2* provide different insights. Additionally, the low correlation between our reserve indicators and both exchange rate regime and credit rating indicators suggest that the relation of reserves with any of these two indicators cannot solely explain the results we obtain. We formally test this insight in the coming section.

3. Preliminary evidence

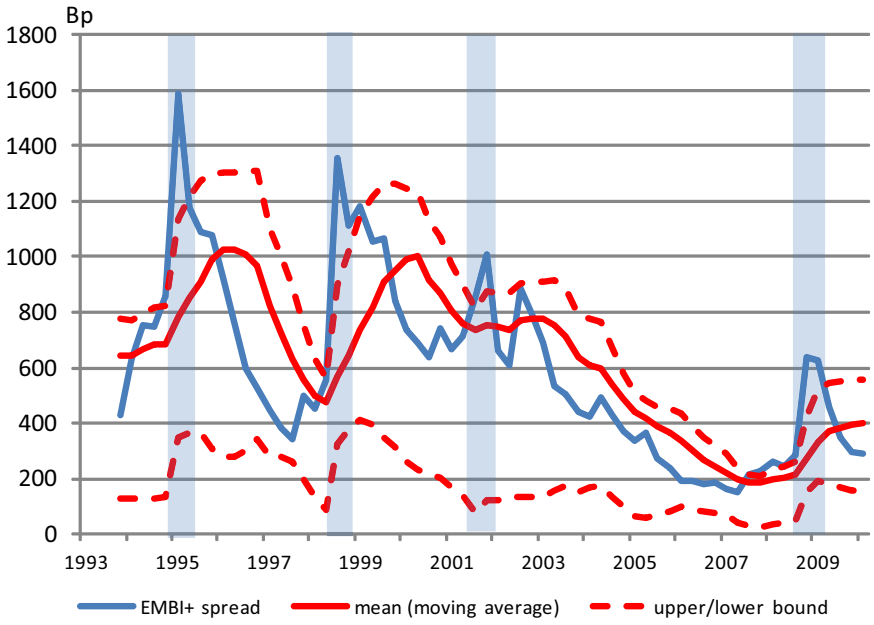
We begin our assessment of the role of reserves in the dynamics of gross flows by plotting their behavior in periods of financial stress both unconditionally and by making such behavior relative to the level of reserves of the countries. [16]

Following Calvo et al. (2008), we use the Global EMBI+ Index to identify periods of global financial stress in emerging economies.[17] The periods of global financial stress are defined as those quarters in which the Global EMBI+ spread (i) is above two standard deviations over its eight-quarter moving average and (ii) reaches the maximum in a four-quarter window. As shown in Graph 2, this methodology returns four events: the first quarter of 1995, the third quarter of 1998, the fourth quarter of

[15] See IMF (2011) for a recent analysis of some of the most popular rules-of-thumb.

[16] For more details, see Alberola et al. (2012).

[17] Importantly, the Global EMBI represents the universe of emerging market sovereign issuers and is not driven by one country's economic condition. It is a measure of risk appetite toward emerging economies as an asset class.



Graph 2. Global EMBI. Events of financial stress. Source: JP Morgan and authors' calculations. Global EMBI-mean is the eight-quarter moving average of the Global EMBI. Upper/Lower bounds are defined as the EMBI-mean plus(minus) the last eight-quarters standard deviation of the Global EMBI. Quarters of financial stress are dashed (1Q95, Q984Q01, 4Q08).

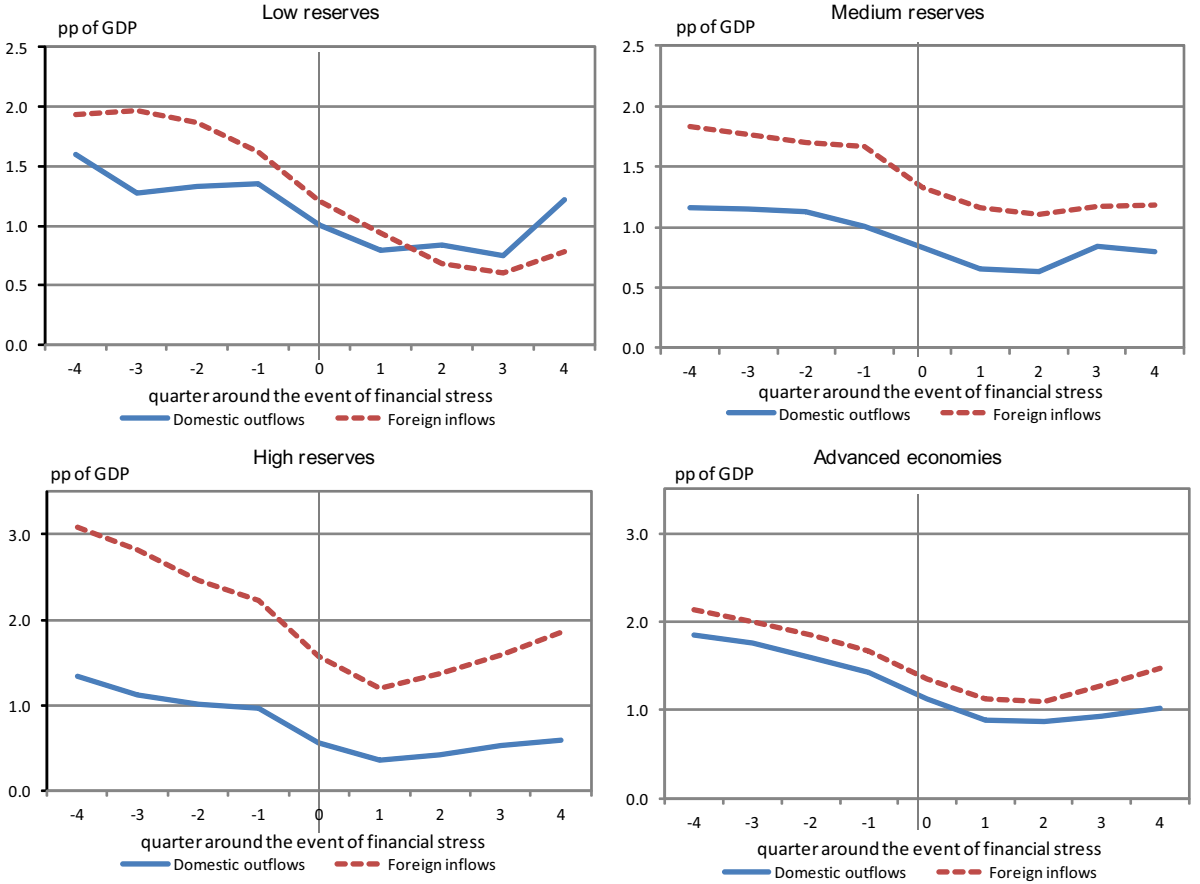
2001 and the fourth quarter of 2008. The graph shows the evolution of the EMBI spread, its time-varying mean and a two standard deviation window around this mean. The quarters identified as events are shadowed, and they correspond roughly, to the Tequila, Russian, Argentinean and Lehman crises.

The next step is to identify how gross flows evolve during these episodes conditioning on the level of reserves held by the different countries' Central Banks. To have a graphical intuition of this behavior, Graph 3 groups countries according to their level of reserves, relative to domestic monetary aggregate, M2, at the onset of each period of financial stress. In the graph, the high-level group comprises those emerging economies with reserves above the 80%. In contrast, the low-level group contains those countries with reserves below the 20% percentile. The rest of the observations enter into the middle reserves group. The advanced countries form an additional group that serves as reference.

Graph 3 below displays the average behavior of gross capital measures for each reserve group. The quarter of the event is defined as $t = 0$, so that we can observe the dynamics for the four periods before and after the event. The red dashed lines represent gross financial inflows by non-residents (*GFI)* and the solid blue lines gross domestic outflows (*GDO)*. Note that GFI plunge around periods of financial stress for all four groups. Conversely, GDO contract somewhat more in advanced countries and high-reserves emerging countries, but not in medium-reserve and low-reserve countries.

This preliminary evidence points at the following pattern: a high level of reserves does not prevent the reduction of capital inflows during stress periods, but it stems domestic financial outflows, helping to mitigate the squeeze in net capital inflows.[18]

[18] This graphical evidence is in line with the econometric event analysis in Alberola et al. (2012). Alberola et al. (2012) confirms that the contraction in outflows is significantly higher the higher the reserves.



Graph 3. Financial inflows and domestic outflows around episodes of financial stress.
Note: Financial inflows and domestic outflows are cumulative last four-quarters flows, measured in GDP terms, standarized by country-specific standard deviation. Emerging economies are classified in three groups according to their ratios of international reserves to M2 in each of the four quarters of financial stress (1Q95, 3Q98, 4Q01, 4Q08). "High reserves" and "Low reserves" include the 20% of countries with highlest/lowest international reserves – the remaining 60% are included as "Medium reserves". Advanced economies are presented as benchmark, irrespective their level of reserves.

4. International reserves during periods of stress: a panel data approach

In this section, we formally test our previous findings in a more comprehensive framework by considering a number of determinants of the behavior of gross capital flows through a panel data analysis. As there is no agreed benchmark where to study the determinants of gross capital flows, we extend the analysis in Cowan et al. (2007) and Broner et al. (2013). Our baseline model includes the country's credit rating, the growth rate of GDP, the current account, the exchange rate regime, the VIX and the EMBI spread as controls. More specifically, we estimate the following equation:

$$\hat{x}_{it} = \alpha + \theta_i + \rho_i t + \delta y_{it-1} + \varepsilon_{it} \quad (1)$$

The model includes a constant, α; country fixed-effects θ_i; country-specific time trends $\rho_i t$; and a vector y_{it-1} that collects the set of (pre-determined) economic controls mentioned above and our metrics of international reserves. We estimate and further augment this model to investigate the role of reserves during financial stress, in the next three sections.

Financial markets view emerging economies as an asset-class. This, as argued by Forbes and Warnock (2012), makes contagion highly likely. To correct for the potential biases that the presence of cross-sectional correlation could create, we also perform the analysis using the Driscoll–Kraay estimator, which allows us to correct for the presence of cross-sectional correlation.

4.1. Basic model: stress periods as dummies

As a first step, we include a crisis dummy in y_{it-1}. This dummy is a binary variable taking value 1 in the quarter of the financial shock and each of the four subsequent quarters, and zero otherwise.[19] In order to gauge the effect of reserves during stress periods, we include among the set of explanatory variables interaction of the crisis dummy with our measures of international reserves. To control for potential non-linear effects associated with sudden stops we include quadratic terms. The simultaneous introduction of reserve indicators, stress indicator and their interaction allows us to interpret the β coefficients as the specific relation between reserves and the corresponding gross flows during periods of financial stress.

Table 1 shows the results for gross foreign inflows (*GFI)* and gross domestic outflows (*GDO)* using reserves measured in terms of the domestic monetary aggregate (*M2*). Table 2 shows the results when reserves are measured as a fraction of international liabilities.

The first and fourth columns in both tables show the benchmark model for GFI and GDO. *Foreign inflows are* positively associated to higher ratings and GDP growth, and negatively correlated with the current account and the EMBI Index. There is no significant correlation with either the VIX or the exchange rate regime indicators. As regards domestic outflows, GDP growth affects positively *GDO*, while the EMBI and VIX indices affect them negatively and significantly. These results, which highlight the pro-cyclicality of gross flows, are similar to those in Broner et al. (2013).[20] In the remaining columns, we extend the model as detailed above model and include the ratio of reserves (linear and quadratic), the crisis dummy, and the interactions of both. The results for inflows and outflows are remarkably different.

Foreign inflows are not significantly affected by reserves, no matter if they are measured in terms of M2 (Table 1) or international liabilities (Table 2). This holds for normal and stress periods, as reflected by the lack of significance of the interaction between crisis and reserves. Only the non-linear term of reserves measured in terms of foreign liabilities has a significant, negative, impact on foreign inflows. Very large reserves seem to accompany a relatively stronger drop in external financing. When

[19] We chose four quarters to match the window analyzed in the event analysis.

[20] Our results are in line with those in Forbes and Warnock (2011) who, focusing on extreme movements on gross flows, find that global factors affect both residents and foreigners' behavior, but domestic macroeconomic factors relate more to foreign flows.

Table 1
Gross capital flows: international reserves to M2.

	Foreign inflows			Domestic outflows		
	(1)	(2)	(3)	(4)	(5)	(6)
	FE	FE	DK	FE	FE	DK
Current account	–0.095***	–0.099***	–0.099***	–0.006	0.008	0.008
	[0.012]	[0.015]	[0.007]	[0.016]	[0.014]	[0.010]
Peg exchange rate	0.279	0.367	0.367**	–0.177	–0.167	–0.167
	[0.304]	[0.315]	[0.144]	[0.227]	[0.197]	[0.182]
Managed exchange rate	0.187	0.199	0.199	–0.141	–0.052	–0.052
	[0.189]	[0.218]	[0.122]	[0.172]	[0.162]	[0.091]
S&P rating	0.100***	0.103***	0.103***	–0.005	–0.001	–0.001
	[0.026]	[0.027]	[0.012]	[0.032]	[0.030]	[0.020]
GDP real growth	0.051***	0.031**	0.031***	0.021**	0.003	0.003
	[0.010]	[0.014]	[0.010]	[0.009]	[0.007]	[0.006]
EMBI	–0.087***	–0.065***	–0.065**	–0.054***	–0.035*	–0.035
	[0.016]	[0.019]	[0.026]	[0.018]	[0.020]	[0.026]
VIX	–0.004	–0.003	–0.003	–0.019***	–0.019***	–0.019***
	[0.004]	[0.004]	[0.006]	[0.006]	[0.006]	[0.005]
EVENT		–0.078	–0.078		0.459*	0.459
		[0.269]	[0.215]		[0.253]	[0.286]
EVENT*IR over M2		–0.010	–0.010		–0.034**	–0.034*
		[0.014]	[0.009]		[0.014]	[0.018]
EVENT*IR over M2, quadratic		0.021	0.021*		0.039**	0.039*
		[0.000]	[0.000]		[0.000]	[0.000]
IR over M2		–0.004	–0.004		–0.024	–0.024***
		[0.016]	[0.005]		[0.018]	[0.007]
IR over M2, quadratic		0.022**			0.015**	0.000**
		[0.000]	[0.000]		[0.000]	[0.000]
Observations	1948	1827	1827	1855	1740	1740
R-squared	0.51	0.54		0.31	0.37	
Number of groups	41	40	40	42	41	41

Notes: Dependent variable "Foreign inflows" includes the investments in each country by non-residents; "Domestic" is defined as the investments overseas by residents. IR stands for International Reserves. M2 stands for domestic monetary aggregates. EVENT is a binary variable which takes value 1 in the quarters of financial stress (1Q95, 3Q98, 4Q01, 4Q08) and the subsequent four quarters. All models include country-specific trends and country dummies. Coefficients of variables including quadratic terms are multiplied by 100. Robust standard errors in brackets, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

we control for cross-sectional correlation (column 3), the results do not change substantially, only the exchange rate regime indicators become significant.[21]

These results are in stark contrast with those for domestic outflows. As reported in Table 1, the event dummy has a positive and statistically significant effect. In emerging economies, domestic outflows are higher during stress times, everything else equal. This result has to be assessed jointly with the impact of ratios of reserves to M2 during stress times. We find that they have a non-linear and statistically significant impact on GDO. The negative-linear and positive-quadratic coefficients indicate that while accumulating reserves initially reduces the outflows, there are decreasing returns to scale to this strategy. This result is robust to using a fixed effect estimator (column 5) or a model that corrects for cross-country correlation (column 6). The results in Table 1 also show that, once we expand the model to include reserves and the crisis dummy, the size of the EMBI coefficient is smaller and less significant (column 5). Indeed, once we control for cross-sectional correlation, the coefficient associated with the EMBI is no longer significant (column 6).

All together, the results suggest that although outflows tend to increase during episodes of financial stress, the stock of reserves mitigates that effect, although such mitigating effect becomes relatively

[21] We find no significant coefficient for the crisis dummy. This is because the information contained on that dummy is already reflected on the EMBI. Still, we need to incorporate the variable to be able to read the interaction term in the way we do.

Table 2
Gross capital flows: international reserves to IL.

	Foreign inflows		Domestic outflows	
	(1)	(2)	(3)	(4)
	FE	DK	FE	DK
Current account	–0.108***	–0.108***	0.003	0.003
	[0.012]	[0.006]	[0.016]	[0.008]
Peg exchange rate	0.295	0.295**	–0.108	–0.108
	[0.312]	[0.135]	[0.197]	[0.157]
Managed exchange rate	0.157	0.157	–0.052	–0.052
	[0.197]	[0.112]	[0.164]	[0.104]
S&P rating	0.081***	0.081***	0.033	0.033*
	[0.029]	[0.014]	[0.026]	[0.018]
GDP real growth	0.042***	0.042***	0.022**	0.022**
	[0.010]	[0.008]	[0.008]	[0.010]
EMBI	–0.062***	–0.062**	–0.026	–0.026
	[0.021]	[0.027]	[0.021]	[0.027]
VIX	–0.001	–0.001	–0.017***	–0.017***
	[0.004]	[0.005]	[0.006]	[0.005]
EVENT	–0.383	–0.383*	0.114	0.114
	[0.275]	[0.223]	[0.315]	[0.228]
EVENT*IR over IL	0.030	0.030	–0.034	–0.034**
	[0.020]	[0.018]	[0.028]	[0.016]
EVENT*IR over IL, quadratic	–0.087**	–0.087***	0.056	0.056*
	[0.000]	[0.000]	[0.001]	[0.000]
IR over IL	0.016	0.016	–0.023	–0.023
	[0.022]	[0.014]	[0.026]	[0.018]
IR over IL , quadratic	0.011	0.011	–0.025	–0.025
	[0.000]	[0.000]	[0.000]	[0.000]
Observations	1859	1859	1773	1773
R-squared	0.54		0.36	
Number of id	40	40	41	41

Notes: Dependent variable "Foreign inflows" includes the investments in each country by non-residents; "Domestic" is defined as the investments overseas by residents. IR stands for International Reserves. IL stands for international liabilities. EVENT is a binary variable which takes value 1 in the quarters of financial stress (1Q95, 3Q98, 4Q01, 4Q08) and the subsequent four quarters. Coefficients of variables including quadratic terms are multiplied by 100. All models include country-specific trends and country dummies. Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1.

less strong as the coverage ratio increases. A similar, albeit less robust, effect is found when we use reserves to financial liabilities (see columns 3 and 4 of Table 2).

4.2. Extensions and robustness checks

The next step to understand the relevance of reserves is to take into account the intensity of the stress. As shown in Graph 2, financial stress fluctuates strongly over time: there are other spikes in financial stress –albeit not to extreme levels – and periods of different financial stability. Moreover, it is evident that the four periods under scrutiny featured different stress intensities.

To gauge the relevance of stress intensity we interact reserve adequacy ratios with our measure of stress, the EMBI spread $EMBI_{it} * RX_{it}$. As before, we include linear and quadratic terms of reserve adequacy. As in the previous specifications, the joint introduction of reserves indicators, the EMBI and the interaction of both allows us to interpret the β coefficients as the specific relation between reserves and $\hat{x}_{it}$ as a function of the degree of financial stress.[22]

Table 3 presents the results on gross domestic outflows, total and short term, respectively. We present the results when international reserves have been scaled using the monetary aggregate M2. As

[22] Accordingly, we drop the crisis indicator, which becomes redundant.

Table 3
Domestic outflows and international reserves to M2: robustness checks and extensions.

	Domestic					Domestic short-term				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Emerging	Advanced	Emerging	Emerging	Emerging	Emerging	Advanced	Emerging	Emerging	Emerging
			Forward looking	Simultaneity	Capital openness			Forward looking	Simultaneity	Capital openness
Current account	0.005	0.057**	–0.002	0.059***	0.004	0.014	0.057**	–0.003	0.061***	0.018
	[0.009]	[0.025]	[0.012]	[0.008]	[0.011]	[0.009]	[0.026]	[0.013]	[0.008]	[0.011]
Peg exchange rate	–0.166	0.000	–0.174	–0.386**	–0.314	–0.329**	0.000	–0.327*	–0.525***	–0.446**
	[0.169]	[0.000]	[0.153]	[0.148]	[0.200]	[0.156]	[0.000]	[0.173]	[0.148]	[0.198]
Managed exchange rate	–0.061	0.000	–0.011	–0.214**	–0.138		0.000	–0.119	–0.311***	–0.246*
	[0.087]	[0.000]	[0.121]	[0.092]	[0.111]	[0.105]	[0.000]	[0.120]	[0.109]	[0.129]
S&P rating	–0.006	–0.009	–0.032	–0.052***	0.021	–0.005	0.030	–0.023	–0.044**	0.021
	[0.019]	[0.082]	[0.027]	[0.018]	[0.024]	[0.021]	[0.077]	[0.029]	[0.019]	[0.026]
GDP real growth	0.008	0.157***	0.015	–0.009	0.007	0.007	0.116***	0.012	–0.010	0.005
	[0.007]	[0.033]	[0.011]	[0.007]	[0.007]	[0.007]	[0.032]	[0.012]	[0.007]	[0.008]
EMBI	0.042	–0.092***	0.074	0.080*	0.043	0.067	–0.107***	0.128**	0.122***	0.066
	[0.047]	[0.027]	[0.063]	[0.040]	[0.051]	[0.043]	[0.028]	[0.051]	[0.035]	[0.041]
VIX	–0.021***	–0.005	–0.030***	–0.017***	–0.017***	–0.024***	–0.015	–0.030***	–0.021***	–0.020***
	[0.004]	[0.012]	[0.008]	[0.003]	[0.005]	[0.003]	[0.010]	[0.008]	[0.002]	[0.003]
EMBI*IR over M2	–0.005**	0.007*	–0.006	–0.005**	–0.006***	–0.006***	0.007	–0.007**	–0.007***	–0.006***
	[0.002]	[0.004]	[0.004]	[0.002]	[0.002]	[0.002]	[0.004]	[0.003]	[0.002]	[0.002]
EMB*IR over M2, quadratic	0.000**	–0.017	0.006	0.005**	0.006***	0.006***	–0.014	0.008*	0.007***	0.007***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
IR over M2	–0.028**	–0.029	–0.030**	–0.020**	–0.023**	–0.027**	–0.047*	–0.026**	–0.023**	–0.022**
	[0.011]	[0.022]	[0.014]	[0.010]	[0.011]	[0.011]	[0.023]	[0.013]	[0.009]	[0.010]
IR over M2, quadratic	0.000*	–0.031	0.029*	0.006	0.020*	0.021*	–0.003	0.027*	0.011	0.019*
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Foreign				0.554***					0.474***	
				[0.031]					[0.032]	
Capital Openness Index					–0.630*					–0.492
					[0.336]					[0.403]
Observations	1773	1148	1736	1768	1419	1784	1148	1747	1779	1430
Number of groups	41	21	41	40	31	41	21	41	40	31

Notes: Dependent variable "Domestic" includes the investments overseas by residents; "Domestic short-term" includes only other investment and portfolio investment overseas. "Foreign" includes includes the investments in each country by non-residents. IR stands for International Reserves. M2 stands for domestic monetary aggregates. All models include country-specific trends and country dummies. Coefficients of variables including quadratic terms are multiplied by 100. All models are estimated with the Driscoll–Kraay estimator. Robust standard errors in brackets, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

expected, reserves to monetary aggregates (M2) is a more relevant metric when studying domestic residents' investment decisions.[23] As before, when we correct for cross-sectional correlation using the Driscoll–Kraay estimator (column 1), the ratio of reserves has a non-linear effect on domestic outflows. Reserves do contribute to reduce domestic outflows, and this effect is stronger the worse financial stress is.

Interestingly, international reserves affect more strongly short-term domestic flows, which are the flows whose dynamics have a more volatile nature. In the case of short-term outflows, the results also hold (Table 3, column 5).

Our analysis so far has focused on emerging economies. We investigate next whether reserves determine as well capital flows dynamics in advanced economies during stress times. We find that the stabilizing impact on domestic outflows we have documented for emerging economies is absent in advanced economies. Indeed, column 2 in Table 3 shows how in advanced economies reserves have quite the opposite effect on domestic outflows: they do increase, as financial stress mounts, the higher international reserves are. Short-term domestic outflows do not depend on reserves in the subsample of advanced economies (column 6). In advanced economies, probably reflecting their character as a source of funds, domestic outflows do contract when financial stress increases.

We investigate next the impact of reserves on domestic capital flows from a forward-looking perspective. In previous results, we have used as dependent variable four-quarter cumulative financial flows. Although the use of cumulative measures is standard in the literature, their use poses a problem in understanding the estimated coefficient as being associated to present instead of past observations. To assess the relevance of such concern we construct a new dependent variable: the sum of financial flows in the current quarter, and three quarters ahead. Such measure allows investigating in more detail the response of capital flows to the explanatory variables. The results, shown in column 7, confirm our previous findings on total and short-term domestic outflows dynamics. Short-term domestic outflows have the expected non-linear relationship with reserves holdings – linear negative effect, positive quadratic term – which increases with the degree of financial stress. Interestingly, they increase with financial stress (measured by the EMBI), as we found previously in Table 1. These results do not hold for domestic outflows (column 3), confirming that short-term flows are more responsive to reserves to M2 as financial stress mounts.

As documented in Broner et al. (2013), domestic outflows and foreign inflows are highly synchronized. For that reason, as robustness test, we introduce them as explanatory variables in the equation (results are shown in columns 4 and 8). Our main results still hold. The results are similar for both overall and short-term outflows; they tend to increase as financial stress increases, but have the aforementioned non-linear relationship with reserve holdings.

Finally, we investigate if our results are robust when we control for capital account openness. As a measure of country's capital account openness, we include the Chinn–Ito index. Results for domestic outflows and short-term domestic outflows are shown in columns 5 and 10. The main findings hold. In fact, we find that for domestic outflows the coefficient of the non-linear terms becomes higher. Our results show that capital account openness is negatively related to domestic outflows. This suggests that, after controlling for other determinants, having more restrictions to financial flows fosters domestic outflows.

We turn now to Table 4 that presents the results for gross financial inflows. As in our benchmark estimation, the results are less robust. For addressing the behavior of foreign investors, we measure reserves as the ratio with respect to international liabilities, which our previous analysis showed to be a more relevant metric. The sign of the control variables remains similar to that of benchmark estimations shown in Tables 1 and 2.

In what follows we focus on the interaction between financial stress, and the ratios of reserves. The results show that gross inflows (GFI) contract when financial stress increases – the EMBI has a negative sign. Reserves to financial liabilities have a non-linear impact on foreign inflows: there is a positive linear effect, which decreases with the level of reserves – since the quadratic term is

[23] Reserves to international liabilities fail to have a significant effect on residents in the robustness checks and extensions.

Table 4
Foreign inflows and international reserves to IL: robustness checks and extensions.

	Foreign					Foreign short-term				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Emerging	Advanced	Emerging	Emerging	Emerging	Emerging	Advanced	Emerging	Emerging	Emerging
			Forward looking	Siimultaneity	Capital openness			Forward looking	Simultaneity	Capital Openness
Current account	–0.103***	–0.082***	–0.028**	–0.104***	–0.113***	–0.099***	–0.085***	–0.026**	–0.101***	–0.115***
	[0.006]	[0.020]	[0.013]	[0.006]	[0.008]	[0.007]	[0.021]	[0.012]	[0.007]	[0.007]
Peg exchange rate	0.281*	0.000	0.273	0.409***	0.166	0.433***	0.000	0.411*	0.554***	0.316*
	[0.140]	[0.000]	[0.206]	[0.133]	[0.143]	[0.147]	[0.000]	[0.234]	[0.133]	[0.166]
Managed exchange rate	0.175	0.000	0.402**	0.270**	0.132	0.246**	0.000	0.359**	0.342***	0.207
	[0.112]	[0.000]	[0.150]	[0.116]	[0.128]	[0.107]	[0.000]	[0.160]	[0.119]	[0.136]
S&P rating	0.082***	–0.168*	0.129***	0.063***	0.081***	0.073***	–0.088	0.110***	0.057***	0.072***
	[0.015]	[0.091]	[0.018]	[0.014]	[0.018]	[0.016]	[0.074]	[0.019]	[0.018]	[0.017]
GDP real growth	0.045***	0.192***	0.052***	0.032***	0.042***	0.048***	0.168***	0.060***	0.038***	0.046***
	[0.009]	[0.033]	[0.012]	[0.007]	[0.009]	[0.009]	[0.031]	[0.013]	[0.007]	[0.008]
EMBI	–0.176***	–0.052*	–0.060**	–0.120***	–0.190***	–0.196***	–0.067**	–0.049*	–0.161***	–0.205***
	[0.026]	[0.027]	[0.024]	[0.032]	[0.029]	[0.027]	[0.026]	[0.028]	[0.036]	[0.028]
VIX	–0.002	–0.007	–0.030***	0.004	–0.000	–0.006	–0.014**	–0.027***	–0.001	–0.005
	[0.005]	[0.010]	[0.007]	[0.004]	[0.005]	[0.004]	[0.005]	[0.008]	[0.004]	[0.004]
EMBI*IR over IL	0.010***	0.001	0.003	0.006**	0.011***	0.012***	0.003	0.001	0.010***	0.013***
	[0.002]	[0.004]	[0.002]	[0.003]	[0.003]	[0.002]	[0.004]	[0.003]	[0.003]	[0.003]
EMBI*IR over IL, quadratic	–0.023***	0	–0.002	–0.014*	–0.023***	–0.027***	–0.008	0	–0.022***	–0.028***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
IR over IL	0.039***	–0.138***	0.000	0.039***	0.038***	0.062***	–0.122***	0.017	0.064***	0.054***
	[0.011]	[0.031]	[0.017]	[0.012]	[0.013]	[0.009]	[0.034]	[0.017]	[0.010]	[0.011]
IR over IL, quadratic	–0.069***	0.273***	–0.032	–0.044*	–0.068***	–0.109***	0.226***	–0.052	–0.095***	–0.103***
	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]
Domestic				0.418***					0.321***	
				[0.031]					[0.032]	
Capital Openess Index					–0.116					–0.225
					[0.342]					[0.267]
Observations	1866	1366	1771	1768	1540	1866	1366	1771	1768	1540
Number of groups	40	21	40	40	31	40	21	40	40	31

Notes: Dependent variable "Foreign" includes the the investments in each country by non-residents; "Foreign short-term" includes only other investment and portfolio investment by non-residents. "Domestic" is defined as the investment overseas by residents. IR stands for International Reserves. IL stands for International Financial Liabilities. Coefficients of variables including quadratic terms are multiplied by 100. All models include country-specific trends and country dummies. All models are estimated with the Driscoll–Kraay estimator. Robust standard errors in brackets, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

negative (column 1). This finding is qualitatively similar to the one found for gross domestic outflows – available financing decreases as financial instability mounts, but reserves have a stabilizing role. There are, however, remarkable differences in the size. These differences are relevant, since, as discussed below, reserve holdings are not enough to prevent a reduction of foreign financing in periods of stress.[24]

The stabilizing role of reserves on gross inflows is specific to emerging economies. Column 2 shows that in advanced economies the interaction terms (linear and quadratic) are not significant. These results are also robust to the inclusion of gross outflows in the equation – to take into account simultaneity of inflows and outflows, in columns 4 and 8 – but not to the use as dependent variable of the cumulative forward-looking financial inflows, in columns 3 and 7. The results are also robust to the inclusion of the Chinn–Ito capital account openness index (columns 5 and 10), which appears to have no statistically significant effect on foreign flows.

Overall, the stabilizing role of reserves is more robust on domestic outflows – in particular, for our short-term measure of capital outflows (including other flows and portfolio flows), and less so for foreign inflows.[25]

4.3. Economic significance of the results

We turn now to discuss the economic significance of the results: the extent to which international reserves impact gross capital flows dynamics as financial stress mounts. The results presented are those obtained from the more robust specification, the one that controls for cross-sectional correlation (column 1 of Table 3 for outflows and column 1 of Table 4 for inflows). We compute and plot the estimated economic joint effect of financial stress and reserves by multiplying the (standardized) effect on capital flows by the median of the country-specific capital flows standard deviation. The standardized effect is obtained by computing the effect of various combinations of reserves and financial stress using the estimated coefficients. We include 95% confidence bands of the estimation.[26]

The effect of reserves, in terms of M2, on domestic outflows, is shown in Graph 4 below. In order to gauge intuition about the importance of reserves during stress periods we compare their effect in two different scenarios. One where the EMBI is at 200 basis points (bps), reflecting normal times, and another one reflecting stress times with a value for the EMBI of 1000 bps.[27]

As shown in the graph, under severe financial stress, a low ratio of reserves – below 10% – can imply higher domestic outflows than in periods of reduced spreads. Moreover, domestic outflows drop sharply up until the coverage ratio is around 60%.[28] Beyond this point, confidence bands widen, as there are very few observations with such high levels of reserves.

To further investigate developments in the tails of the distribution of reserves, we run threshold regressions. We use the benchmark equation, keeping the linear interaction term between reserves and the EMBI; however, we substitute the quadratic term by dummies which take value 1 if observations are above a given threshold of reserves and 0 otherwise. We define three dummies, using as thresholds the percentiles 10%, 90%, and 95%; they correspond to coverage ratios of 10, 64, and 82, respectively. The results are reported in Table 5, panel A. Column 1 shows that the coefficient of the percentile 90 dummy is positive and statistically significant, confirming the existence of decreasing returns to reserve accumulation. The dummy of percentile 10, though, is not statistically significant, suggesting very low reserves might not have a marginally stronger effect. We also split these observations in two groups: those included within the 90th and 95th percentiles, and those above the 95th percentile. We find that only observations in the first bucket display a significant impact on domestic

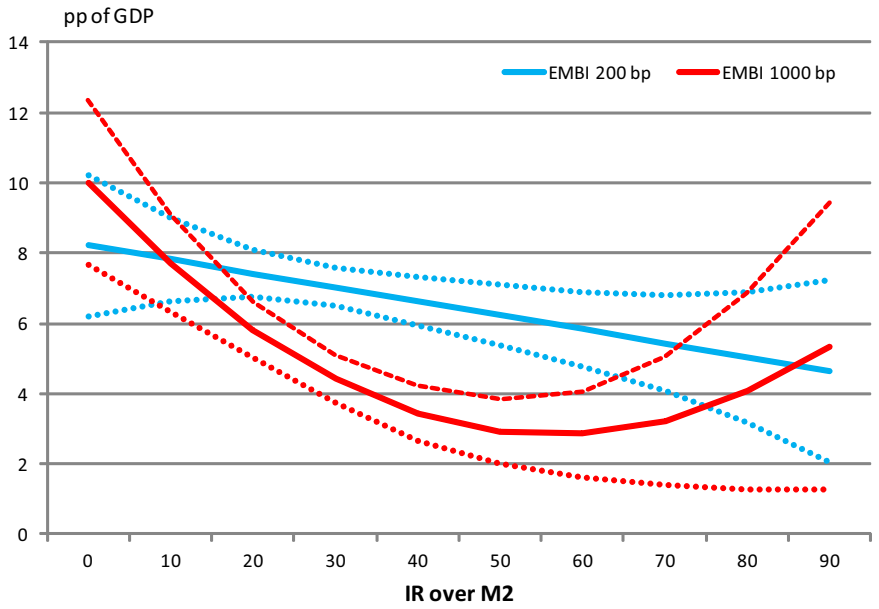
[24] As we discuss below, these differences are so significant that the net effect during financial stress are quite the opposite.

[25] In unreported exercises, we run all regressions on two different time subsamples: 1991–2000 and 2001–2010. We find that the results are stronger, particularly for short-term outflows, for the 2000–2010 subsample, which has twice the observations of subsample 1991–2000. We interpret that the role of reserves has become more important over time.

[26] We measure the rest of the explanatory variables at their means: this way we show the marginal effect of international reserves to M2, for the average emerging economy (the VIX is also measured at its mean).

[27] One thousand bps is the average EMBI spread on the four episodes of financial stress in our sample.

[28] Since the bulk of observations of reserves to M2 are below 80%, we focus on the interval 0–80%.



Graph 4. Domestic outflows. Relevance of International Reserves to M2 during financial stress.
Note: IR stand for International Reserves. IR measured relative to M2. Graph is constructed using the coefficients of column 1 of Table 3. All the variables, but IR to M2 and the EMBI, are measured at their average values. IR over International Liabilities are measured in an interval which comprises 99% of the observations. Global EMBI is measured at two values: 1000 bp is the average of the Global EMBI during the four events of financial stress, while 200 bp is the average value of the last twelve quarters before the global financial crisis. Domestic outflows are re-escalated with their corresponding average standard deviation. Dotted lines are 95% confidence intervals.

outflows. There is no significant effect specific to the observations with the higher reserves. This shows that results become blurred for very high values of reserves. Overall, these results confirm our interpretation that nonlinearities exist; but patterns in the tails of the distributions need to be interpreted with caution. As a result, and given our previous discussion on the lack of observations on that tail, we abstain from extracting any conclusion from the turnaround observed at higher and lower levels of reserves. What matters to our analysis is that, as financial stress increases, higher levels of reserves to M2 feature less domestic outflows.

In turn, Graph 5 shows the effect of reserves, in terms of international liabilities, on financial inflows. A first issue worth mentioning is that, at high EMBI levels, financial inflows are lower for any ratio of reserves to financial liabilities. At low levels of stress – low spreads – financial inflows are stronger where ratios of reserves are higher. This changes once financial stress mounts. At higher spreads, reserves mitigate the reduction in capital inflows. Interestingly, this effect shows decreasing returns to scale, as additional increases in the coverage ratio improve financial inflows relatively less.

As before, we also run threshold regressions. Again, we look at percentiles 10%, 90%, and 95%, which correspond to ratios of reserves to international liabilities of 7, 33, and 40.[29] The results, shown in panel B of Table 5, are less robust. Foreign inflows are negatively related to the EMBI, but the interaction term fails to be significant; we find that if reserves to international liabilities are over the percentile 90% foreign inflows are lower during financial stress (column 1); being below percentile 10% has no statistically significant impact on foreign inflows. We obtain similar results for short-term foreign inflows

[29] The bulk of observations of reserves to international financial liabilities are below 50% (slightly below percentile 99%), so we analyze that interval.

Table 5
Gross capital flows: threshold regressions.

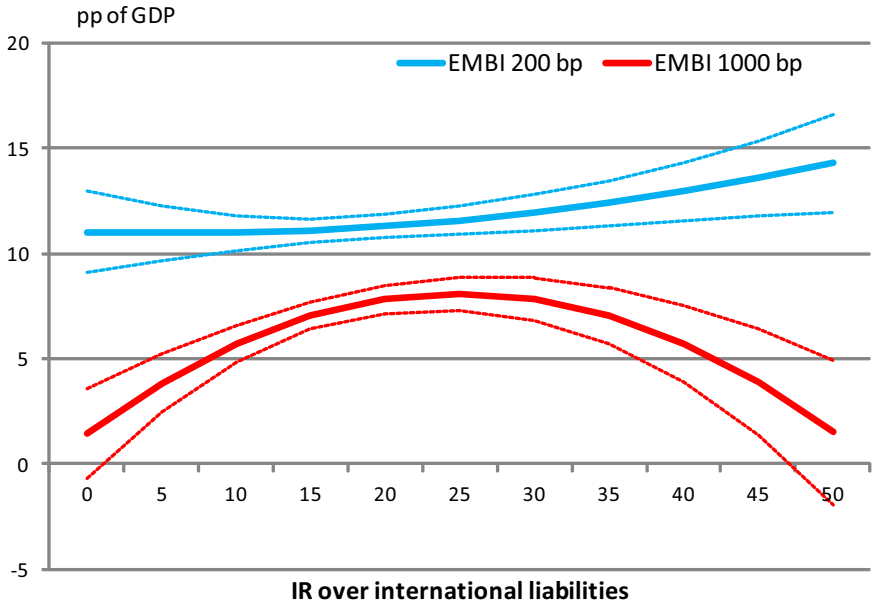
Panel A. Domestic outflows and international reserves to M2

	Domestic outflows			Short-term domestic outflows		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dummy Percentile 90% IR to M2	Dummy Percentile 95% IR to M2	Dummy Percentile 10% IR to M2	Dummy Percentile 90% IR to M2	Dummy Percentile 95% IR to M2	Dummy Percentile 90% IR to M2
EMBI	–0.018	–0.016	–0.023	–0.003	–0.003	–0.015
	[0.034]	[0.033]	[0.030]	[0.028]	[0.027]	[0.026]
EMBI*IR over M2	–0.001**	–0.001**	–0.001*	–0.001**	–0.001**	–0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
IR over M2	–0.010**	–0.009**	–0.007	–0.010**	–0.010**	–0.007
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]
EMBI*Dummy IR over M2, p95		0.019			0.028	
		[0.053]			[0.057]	
EMBI*Dummy IR over M2 p90-p95		0.047**			0.049**	
		[0.018]			[0.018]	
EMBI*Dummy IR over M2, p90	0.046**			0.048**		
	[0.019]			[0.019]		
EMBI*Dummy IR over M2, p10			–0.023			0.011
			[0.038]			[0.030]
Observations	1419	1419	1419	1430	1430	1430
Number of groups	31	31	31	31	31	31

Panel B. Foreign inflows and international reserves to IL

	Foreign inflows			Short-term foreign inflows		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dummy Percentile 90% IR to FL	Dummy Percentile 95% IR to FL	Dummy Percentile 10% IR to FL	Dummy Percentile 90% IR to FL	Dummy Percentile 95% IR to FL	Dummy Percentile 90% IR to FL
EMBI	–0.112***	–0.102***	–0.090***	–0.114***	–0.104***	–0.091***
	[0.026]	[0.026]	[0.026]	[0.025]	[0.025]	[0.028]
EMBI*IR over IL	0.002	0.001	0.000	0.002	0.001	0.001
	[0.002]	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]
IR over IL	0.014	0.008	0.005	0.015	0.009	0.005
	[0.010]	[0.010]	[0.009]	[0.009]	[0.009]	[0.009]
EMBI*Dummy IR over IL, p95		0.008			–0.005	
		[0.026]			[0.032]	
EMBI*Dummy IR over IL p90-p95		–0.027			–0.031	
		[0.027]			[0.033]	
EMBI*Dummy IR over IL, p90	–0.053**			–0.060**		
	[0.022]			[0.022]		
EMBI*Dummy IR over IL, p10			–0.025			–0.022
			[0.025]			[0.023]
Observations	1540	1540	1540	1540	1540	1540
Number of groups	31	31	31	31	31	31

Notes: In Panel A dependent variable "Domestic" is defined as the investment overseas by residents; in Panel B "Foreign" is defined as investments in each country by non-residents. IR stands for international reserves; FL stands for international liabilities; M2 stands for monetary aggregates. Dummies p10 include observations below percentile 10th; dummies p90(95) include observations above percentile 90th(95th); dummies p90–p95 include observations comprising between percentiles 90th and 95th. All models include the current account, exchange rate dummies, S&P rating, real GDP growth, capital openess index, the VIX, country-specific trends and country dummies. Standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.



Graph 5. Foreign inflows. Relevance of International Reserves to IL during financial stress
Note: IR stands for International Reserves. IR is measured relative to International Liabilities. Graph is constructed using the coefficients of column 1 of Table 4. All the variables, but IR to International Liabilities and the EMBI, are measured at their average values. IR over International Liabilities are measured in an interval which comprises 99% of the observations. Global EMBI is measured at two values: 1000 bp is the average of the Global EMBI during the four events of financial stress, while 200 bp is the average value of the last twelve quarters before the global financial crisis. Foreign inflows are re-escalated with their corresponding average standard deviation. Dotted lines are 95% confidence intervals.

(columns 4 to 6). The results suggest that a nonlinear effect exists, although it is not as strong as the one on outflows.

Summing up, the results of this exercise provide very robust evidence that international reserves might be relevant during financial stress in a somewhat unexpected way. While they do not prevent a reduction in inflows by foreign investors – albeit higher reserve coverage ratios can mitigate it – they facilitate financial retrenchment by resident investors. The economic significance of the effect during periods of financial stress is substantial. Domestic outflows might contract up to six percentage points of GDP for an average country and mitigate the reduction in capital inflows in the order of five percentage points of GDP.[30] Such reduction contributes to stabilize the generalized drought in foreign financing which emerging economies frequently experience during financial stress.

5. Conclusions

In this paper, we characterize the dynamics of gross capital flows around periods of global financial stress and relate them to the countries' holdings of international reserves. In contrast to previous contributions focusing on net flows, we delve into gross capital inflows and outflows.

We document stark differences across countries in financial flow dynamics around periods of global financial stress depending on the level of reserves. In advanced countries foreign inflows and domestic outflows contract in a systemic way. Conversely, in emerging economies, while financial inflows

[30] According to our estimates, outflows contract 1.5 percentage points of GDP more for countries with a ratio of reserves to M2 one standard deviation above the average.

do fall no matter what the level of reserves, domestic outflow dynamics change depending on international reserve holdings. In high-reserve countries domestic outflows are significantly lower during financial stress while in low-reserve countries there is no such retrenchment, and we even find signs of capital flight. This led us to hypothesize that reserves play a catalytic role vis-à-vis resident investors.

To assess the robustness of this result we have presented panel data evidence where we controlled for additional factors. Our results suggest that capital flows are pro-cyclical and that country-specific variables are less important in explaining gross domestic outflows than global factors. More importantly, our panel results provide robust evidence that international reserves are associated with a mitigation of the reduction of financial inflows and with a higher propensity of resident investors to repatriate capital invested abroad during periods of global stress. Cowan et al. (2007) and Broner et al. (2013) document that, on average, domestic capital retrenches during crises, a result in contrast to the notion of recurrent domestic capital flight documented in Forbes and Warnock (2012) and Rothenberg and Warnock (2011). Our results show that taking into account the stock of reserves held by the Central Bank is one way to reconcile these two sets of results. Countries with low reserves are more likely to see their residents place their capital abroad during crises. The opposite happens when a country's Central Bank has an abundant stock of reserves. These results challenge current approaches to measuring reserve adequacy, and call for refining such tools to better account for the role of resident investors.

Appendix

Countries under study

Advanced economies: Australia; Austria; Canada; Denmark; Finland; France; Germany; Greece; Italy; Japan; Netherlands; New Zealand; Norway; Portugal; Spain; Sweden; Switzerland; UK; US.

Emerging economies: Argentina; Armenia; Azerbaijan; Bangladesh; Belarus; Bosnia-Herzegovina; Brazil; Bulgaria; Cambodia; Colombia; Croatia; Czech Rep; Chile; Ecuador; Estonia; Georgia; Hungary; India; Indonesia; Israel; Jordan; Kazakhstan; Korea; Latvia; Lithuania; Macedonia; Malaysia; Mexico, Moldova; Morocco; Pakistan; Peru; Philippines; Poland; Romania; Russian Federation; Singapore; Slovak Rep.; Slovenia; South Africa; Thailand; Turkey; Uruguay; Venezuela.

Data description

Financial flows: Data come from IMF's International Financial Statistics (IFS). The variables used to compute gross financial outflows are Direct Investment Abroad (line 78 bdd), Portfolio Investment Assets (line 78 bfd), Other Investment Assets (line 78 bwd) and Changes in reserves (line 79 dbd). On the other hand, gross financial inflows include Direct Investment in the Reporting Economy (line 78 bed), Portfolio Investment Liabilities (line 78 bgd) and Other Investment Liabilities (line 78 bid).

International financial liabilities and M2: We construct data on international financial liabilities mixing the updated version of the External Wealth of Nations Mark II database (Lane and Milesi-Ferretti, 2007) with data from IFS. We consider the first source more reliable for earlier dates. Data, on an annual basis, were interpolated to obtain quarterly figures. In terms of IFS coding, the variables employed are International financial liabilities (line 79 lad) and reserve assets (line 79 akd). We measure of M2 as the sum of lines 34 and 35, from International Financial Statistics.

Data on financial spreads and credit ratings: We use the JP Morgan Emerging Market Bond Index (EMBI) Global (less liquid but more diversified than the EMBI+), which is a traditional, market-capitalization-weighted index. The credit ratings were obtained from Standard & Poor's.

Exchange rate regime: Exchange rates regimes are classified using the Ilzetzki et al. (2010) classification. This classification takes four values, from 1 to 4, with 1 being the most fixed regimes and 4 the most flexible. We regroup them in three groups: a "fixed exchange rate regime" group comprising observations with a value 1; a "managed exchange rate regime group", comprising observations with values 2 and 3; a "flexible exchange rate regime", comprising observations with a value 4.

VIX index: We obtained the VIX index, as produced by the Chicago Board Options Exchange, from Datastream.

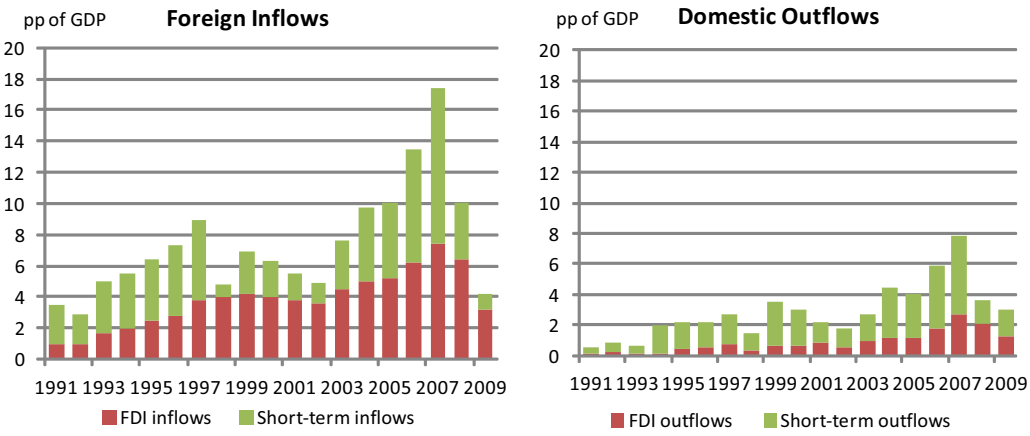


Chart A1. Gross capital flows composition.
Note: Simple average of all emerging economies. Short-term inflows/outflows include portfolio flows and other investment. Gross flows are measured in terms of domestic GDP.

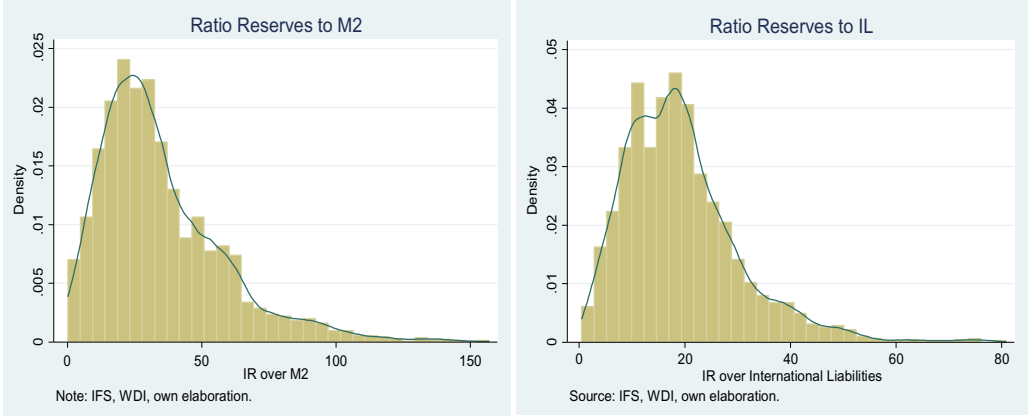


Chart A2. Distributions of international reserve ratios for emerging economies.
Note: The chart displays the histogram of the distribution of reserves for each of the two ratios used in the analysis. In each graph, a kernel is overlaid.

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