Accumulation of Reserves in Emerging and Developing Countries: Mercantilism vs. Insurance

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Abstract
Motivated by the significant increases in international reserves during the 2000s, this paper analyzes the reasons why emerging and developing countries choose to accumulate them. In addition to a traditional measure of mercantilism, we add the terms of trade, and the speculation-deterrent motive. The results show that the mercantilist motive was a significant factor behind the massive accumulation of reserves before the global financial crisis, and it was almost as important as the precautionary motive. It is shown that commodity-exporting countries increased reserves for a fundamentally mercantilist motive. Finally, the speculation-deterrent motive was also an important factor during the 2000s.

Keywords: International reserves, mercantilism, precaution, self-insurance.
JEL Classification Numbers: F21, F3, F30, F31, F36

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1.   Introduction

Across emerging market economies, the 2000s were characterized by massive accumulation of international reserves. It was a key feature of the global landscape. There were intense policy discussions, from insurance needs to currency manipulation, as well as important research on the causes and consequences of reserve accumulation. In their influential study, Aizenman and Lee (2007) argue that countries maintain international reserves for two main reasons. First, as a precautionary motive, to self-insure against foreign financial shortfalls, such as sudden stops or capital flights, which cause negative effects on economic activity and trigger financial turbulences. And second, due to a mercantilist motive, to weaken their currency to promote export-led growth.

Most calibrations of the optimal level of reserves have focused on the precautionary motive, where international reserves act as a buffer to absorb transitory shocks to the balance of payments. Heller (1966) pioneered this research, affirming that reserves can allow countries to buy time for a gradual adjustment in the balance of payments. Frenkel and Jovanovic (1981) argue that they serve as a buffer stock whose role is to accommodate fluctuations in external transactions, implying that the optimal stock of reserves depends positively on these fluctuations. In turn, Edwards (1983) shows that countries that peg the exchange rate have a demand for reserves that is different from those that have used occasional devaluations to correct balance of payments imbalances. The latter group maintains lower levels of reserves, although it adjusts them more quickly to their desired level.

In recent decades economies have become more exposed to external financial shocks as financial integration has grown over time. In this context, one of the most studied issues within the precautionary motive has been avoiding financial crises and mitigating sudden stops. Some research has found that maintaining reserves reduces the likelihood of crises and the costs associated with them.[1] Other research has argued that a loss of confidence in the local currency (as measured by M2 over GDP) or high levels of short-term debt are important reasons for maintaining reserves.[2] In all these cases the authorities have a larger war chest to use in times of turmoil.

Although most authors claim that the precautionary effect serves the purpose of smoothing shocks to foreign financing, a large stock of reserves also acts as a deterrent to currency speculation, and hence even if not used, they still play a stabilizing role. Indeed, this is consistent with a fact discussed later, namely, reserves are rarely used, at least massively (De Gregorio 2014). Cheung and Qian (2009) have suggested that the high level observed in international reserves could be a response to an implicit rivalry among economies that gives rise to a comparative hoarding mechanism, the so-called "Joneses effect". Thus, a high level of international reserves compared with peer economies can deter speculative pressures and reduce the chances of bearing a currency attack. When speculators look at currencies with

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[1] See García and Soto (2006); Jeanne and Rancière (2011); Calvo et al. (2013).
[2] See Obstfeld et al. (2010) and De Beaufort et al. (2001).

greater potential of being successfully attacked, they compare the relative size of their reserves. This is part of the precautionary motive, and we call it the deterrent effect.

There is also a sizable literature that evaluates jointly the roles of both motives for reserve accumulation. Aizenman and Lee (2007) started this type of study by quantifying the relative importance of these two motives for the years 1980-2000. Their results show that both motives are significant, though the precautionary motive carries greater economic weight when it comes to explaining the increase in reserves. Along this same line, Delatte and Fouquau (2011) find evidence that the elasticities change over time, i.e., the demand for international reserves shows a nonlinear behavior. Additionally, they support the mercantilist view through a nonlinear approach. Finally, Ghosh et al. (2017) show that motives have varied over time. They conclude that undervaluation of currencies became more important around 2000, which can be associated with a deliberate undervaluation strategy following a mercantilist motive. In this paper, we want to go further by distinguishing explicitly the roles of the precautionary motive in its traditional version and also as a deterrent of speculation, and of mercantilist motive.

Despite the relevance of the issue, there is still no consensus regarding the main cause of the surprising increase in reserves, what the appropriate method should be for measuring the mercantilist motive, or how important it was during the massive accumulation of the 2000s. This paper investigates the motives that drove the hoarding of international reserves in emerging and developing countries between 2000 and 2013, mainly focusing on the period comprised in 2000-2008.[3] To address this question, we follow the route of the joint estimation of the mercantilist and precautionary motives for reserve accumulation. Moreover, we present a complementary measure of the mercantilist motive through the terms of trade (*ToT*), together with a different proxy for the traditional measure that uses economic growth. Indeed, as we argue below, the conventional manner to estimate this motive —exchange rate overvaluation— has severe problems that our measures prevent. We also separate explicitly the precautionary motive between self-insurance and speculation deterrent. The main contribution of this paper is to present an estimation including all the motives for reserves accumulation, and complementing the mercantilist measure using the terms of trade.

The traditional approach has measured the mercantilist motive through currency undervaluation and export growth or excess export growth (e.g., Ghosh et al. 2017). However, these measures have, beyond causality issues, problems to a correct interpretation of mercantilism. Actually, these approaches assume that undervaluation and high export growth are caused by the accumulation of reserves.[4] Many countries begin accumulating reserves for mercantilist reasons when their currency is relatively strong.[5] The use of undervaluation is

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[3] The sample consists of 52 countries (see table 7).
[4] Indeed, Ghosh et al. (2017) observe that the undervaluation detected in the data could be caused by currency crises. On the other hand, in Pina (2015) central banks optimally accumulates international reserves in order to face large fiscal shocks that need monetary financing. As a consequence, nominal exchange rate depreciates during the accumulation process.
[5] See Adler and Tovar (2011) and De Gregorio (2011).

not capable of capturing this effect, since the currency would probably start overvalued. In addition, to have a positive relationship between the level of reserves and currency undervaluation, one needs to assume that interventions are effective in weakening the currency, which is not obviously the case. Finally, what could affect the exchange rate is the accumulation of reserves, not their level. These concerns are also valid when export growth is used as an indication of mercantilism.

In this paper we identify mercantilism using the terms of trade, which does not experience econometric and economic problems inherent in the traditional methods used to measure the mercantilist motive. The reason to use this variable is that an improvement in the *ToT* induces a real exchange rate appreciation, plus a fall in competitiveness in the sectors not affected by the terms of trade gain. Thus, policymakers may have an incentive to intervene in the foreign exchange market to mitigate the effect of the terms of trade gain, which could be combined with capital controls in other cases.[6] This hypothesis is reaffirmed by the fact that the accumulation of international reserves can cushion the effects on the real exchange rate that have resulted from a *ToT* shock.[7] Thus, the accumulation of reserves in the presence of positive *ToT* would reveal a mercantilist motive. This is particularly relevant in our sample period since the commodity price boom took place in it.

In addition, the traditional mercantilist approach focuses on hoarding international reserves as a by-product of an industrial policy to prevent or mitigate exchange rate appreciation and gain export competitiveness (see Aizenman and Lee 2007). Thus, a country growing faster than its competitors could increase reserves in order to delay a real appreciation that would harm this advantage. For this reason and for the concerns related to the variables traditionally used to measure the mercantilist motive we use also GDP growth as indicative of mercantilism. Consequently, the mercantilist motive is captured through two components: to mitigate the effect of increases in the *ToT* over the exchange rate, and to reduce a fall in competitiveness in the exporting sectors when the economy is growing fast (traditional approach).

Our analysis also splits the precautionary motive into two components. The first is the traditional self-insurance, by which reserves are accumulated to face foreign financing fluctuations. Therefore, the traditional variables related to current and financial accounts' vulnerabilities are used to capture this motive. The second one is the deterrent effect, which is proxied by the level of reserves of the remaining emerging and developing markets. Countries should have high reserves to prevent an attack on their currency, however what is meant by "excessive" depends on the level of reserves of other countries. Finally, we use our model to analyze what motive for maintaining reserves predominates when we divide our sample of

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[6] Recent empirical and theoretical works have found that a combination of capital controls and reserve accumulation could improve welfare in an open economy which experiences external shocks (see Benigno and Fornaro 2012; Bussière et al. 2015; Korinek and Servén 2016; Choi and Taylor 2017).

[7] Aizenman and Riera-Crichton (2008) show that maintaining international reserves has the effect of mitigating the impact of *ToT* shocks on the real exchange rate.

countries between those that are commodity exporters and those that are not (henceforth, "other countries").

The paper follows in section 2 with a brief discussion on the stylized facts on reserves accumulation and their behavior during the global financial crisis. Then, the main results, methodology and description of data are presented in section 3. In section 4 we perform robustness checks for the mercantilist motive and a decomposition of reserves hoardings during the period 2000-2008. Section 5 concludes.

2.   Stylized facts during the global financial crisis

During the 2000s, emerging market economies initiated a massive process of international reserves accumulation. This originated in the need to take precautionary measures after the Asian crisis. However, few years later started a significant rise in commodity prices that led to a currency appreciation and the attempt to stem the strength of the currency in many commodity exporting countries. Following this process, a large body of literature has developed to understand the reasons why countries accumulated reserves, concluding that it was a combination of the mercantilist and precautionary motives (see Aizenman and Lee 2007; Delatte and Fouquau 2011; Ghosh et al. 2017). This was particularly intense in some Asian countries, especially China. The process was also significant, but at a lower scale, in commodity exporting countries (figure 1). This practice culminated during the global financial crisis. Indeed, the average holdings of reserves in 2013 were like those of the pre-crisis year.[8] The dynamic of accumulation changed during 2009-2013.[9]

The global financial crisis had devastating effects on the world economy. Several emerging market economies were hit strongly and some of them used up their reserves during the most turbulent times of the crisis. At the same time, there was massive depreciation of emerging market currencies. However, as Aizenman and Sun (2012) show, the use of reserves was limited by the "fear of losing international reserves." Indeed, the self-insurance motive would suggest that reserves must have been used in important magnitudes, especially in the face of disruption in global financial markets.

A first approach to the evidence would be to quantify the extent of depletion. Following De Gregorio (2014) we use two comparisons, and contrast this evidence with the experience during the Asian crisis. We first compute the 12-month maximum change in reserves and, second, the difference between the maximum and minimum reached before and after the crisis erupted. Figure 2 shows for both measures that the decline during the global financial crisis was about 10 percent, significantly less than during the Asian crisis, where reserves fell

[8] There were some exceptions like the case of China, which kept accumulating in absolute terms until 2013, although this was not the case of the reserves to GDP ratio (see Aizenman et al. 2014).
[9] This fact has been discussed by Aizenman et al. (2015), who show that the reasons for reserves accumulation during 1999-2006 were different from those of 2007-2009 and 2010-2012.
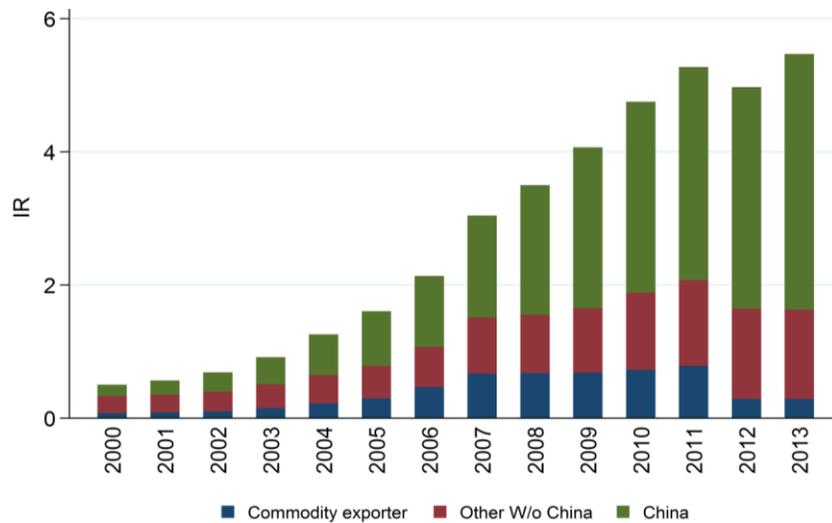
Figure 1. International reserves (trillions of USD). Emerging and developing countries, 2000-2013. Source: WDI-World Bank.

more than 20 percent.[10] In contrast to the Asian crisis, where commodity exporters used significant amounts of reserves, during the global financial crisis the dispersion across the group of countries was not significant. This behavior is at odds with the simple self-insurance motive, since we would have expected larger depletion in the last crisis, and larger depletion among commodity exporters that were more exposed to the sharp decline in their export prices.

The evidence from the Asian crisis reveals indirectly the existence of fear of floating. Indeed, as commodity prices declined significantly in those years, there was more use of reserves by commodity exporters to limit the extent of the depreciation. In contrast, this evidence would suggest that fear of floating was not a relevant issue during the global financial crisis. For this reason, the accumulation of reserves has been asymmetric since the 2000s. It has been done for mercantilist motives, to avoid the appreciation, rather than to limit depreciation, as was the case with fear of floating.

The fact that reserves were not massively used does not necessarily imply the non-existence of a precautionary motive. Some other reasons should be at work. Indeed, this is consistent with the view that holding reserves, without the need to use them, acts as a deterrent against currency speculation and capital outflows, because they represent a signal of strength (Cheung and Qian 2009; De Gregorio 2014; Dominguez et al. 2012). Along this line Alberola et al. (2016) show that in countries with abundant reserves, domestic outflows are significantly less during periods of financial distress. Thus, reserves accumulated before the crisis obeyed also to a precautionary reason, even if their actual use was limited.

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[10] A similar result is found by Bussière et al. (2015) in a broad sample of developing and emerging economies. They show that countries with very high or very low reserves relative to short-term debt did not use much of their reserves during the global financial crisis.
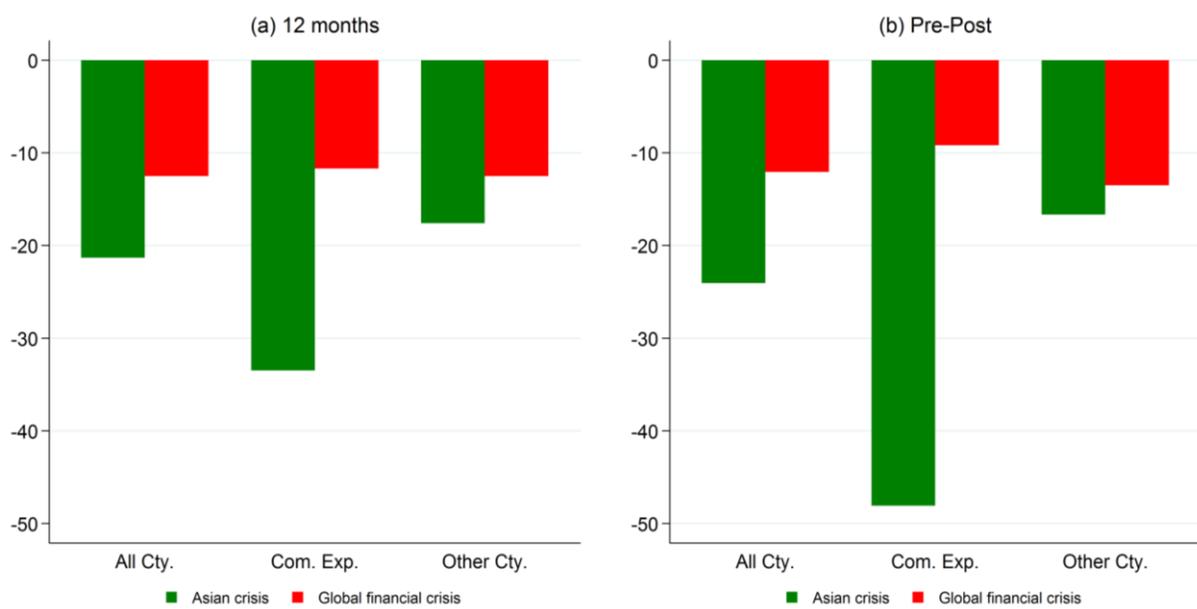
Figure 2. Maximum decline in international reserves (median, percent), Emerging and developing Countries.
Note: The decline in reserves in panel (a) "12 months" is measured as the maximum decline in 12 months from January 1998 to January 2001 for the Asian crisis and from April 2008 to April 2010 for the global financial crisis. "Pre-Post" in panel (b) shows the maximum decline from the maximum level reached before the crisis –January 1997 to August 1998 for the Asian crisis and April to September 2008 for the global financial crisis —and the minimum post-crisis— September 1998 to January 2001 for the Asian crisis and October 2008 to April 2009 for the global financial crisis.
Source: WDI-World Bank.

Moreover, the fact the high amounts of reserves were not used during the crisis is also consistent with the mercantilist motive for accumulation. The mercantilist view implies that reserves follow an asymmetric dynamic. During periods of strong currency and good external conditions countries accumulate reserves, and, since the deterioration of the external environment results in currency depreciation, they are not used up to take advantage of the gains in competitiveness. As argued above, a symmetric behavior is more consistent with fear of floating. Figure 3 shows that average terms of trade across emerging markets displayed a positive trajectory before the crisis, although with significant variation among them. During this commodity price boom exchange rate tensions mounted, inducing appreciation of the currencies. The good external environment and the increasing value of the domestic currency facilitated the accumulation of reserves. In contrast, since the crisis started there was a sharp decline in the terms of trade, and they recovered the original pre-crisis level, but they did not experience an acceleration as in the first half of the 2000s. After the crisis, the behavior of the terms of trade has been more volatile without a clear trend, reducing incentives to accumulate reserves for mercantilist reasons. Indeed, in our empirical investigation we use the terms of trade as an indicator of the mercantilist motive.

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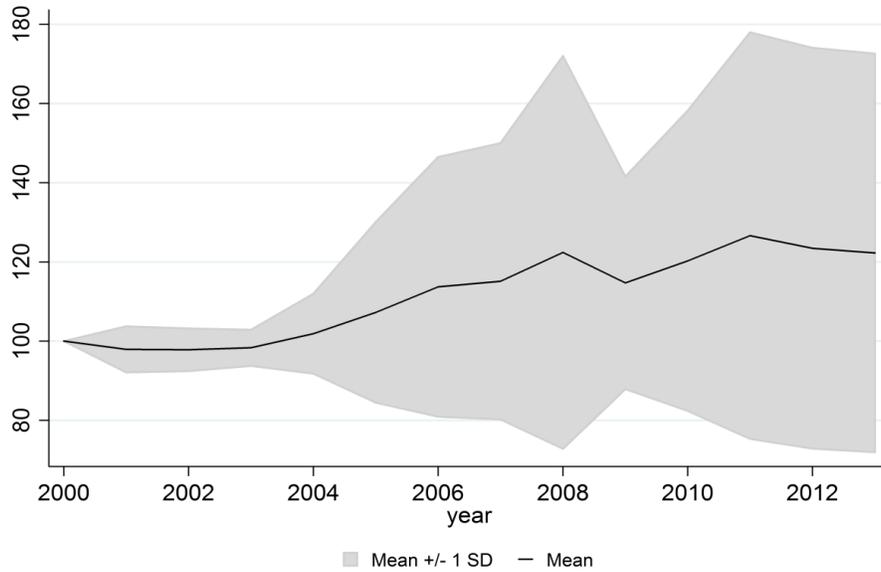
Figure 3. Evolution in terms of trade. Emerging and developing countries, 2000-2013.
Note: The solid black line corresponds to the mean in each period of our entire sample of countries, and the shadow gray area is one standard deviation (SD) in each period of our sample of emerging and developing market economies.
Source: WDI-World Bank, index 2000=100.

3.   Empirical implementation and regression results

We begin this section by presenting the data and specification to then present the main results. Robustness checks of the mercantilist motive as well as a decomposition of reserve accumulation during 2000-2008 in the different motives identified in this paper are done in the next section.

3.1   Data and Specification

Our analysis is conducted using panel data at a yearly frequency for a sample of 52 emerging and developing market economies during the period 2000-2013.[11] In our baseline case, we use the following specification:

$$ln(IR/GDP_{trend})_{it} = \alpha_i$$
$$+ \beta_1 * Terms\ of\ Trade_{i,t} + \beta_2 * GDP\ growth_{i,t-1}$$
$$+ \gamma_1 * Comparative\ h._{i,t}$$
$$+ \gamma_2 * Current\ account\ vars._{i,t} + \gamma_3 * Financial\ account\ vars._{i,t}$$
$$+ \delta * Control_{it} + u_{it} \tag{1}$$

The subindices i and t represent country and time, respectively. We use country fixed effects. Following Obstfeld et al. (2010), in order to control for the potential positive autocorrelation,

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[11] Cheung and Ito (2009) show that major global financial disturbance, where stability breaks down, modifies international reserves hoarding. Therefore, our sample period was chosen to start after the Asian Crisis and it is interrupted by the global financial crises in 2008. This is basically the period of the commodity price boom pre global financial crisis. We also look at some years after the crisis.

the standard errors are clustered by country to control for heteroscedasticity across countries and unstructured serial correlation in the error terms.[12]

The standard literature has used reserves over GDP to measure the dependent variable. However, the denominator of this variable is contaminated by business cycle and exchange rate fluctuations. Thus, we can have rising reserves because of a decline in output or the depreciation of the currency, without changes in the actual stock of reserves. To avoid distortions due to these effects we use the trend GDP measured in current dollars during each sample period.[13]

As discussed in the introduction we distinguish two motives for reserve accumulation: the mercantilist and the precautionary motives, as previous researches have recognized. The mercantilist motive is captured through *ToT* and economic growth. Regarding the precautionary motive, we divide it into two components: (i) self-insurance, which corresponds to reserves accumulated to offset changes in the availability of capital inflows. For this reason, international reserves should cover volatility in the current and the financial accounts; (ii) deterrent, or *comparative hoarding*, which is the buildup of a sufficiently large level of reserves, compared to other countries, to prevent speculators from attacking the currency. The difference between the two components of the precautionary motive is that while self-insurance presumes reserves will be used at times of curtailment of international financing, deterrent helps to avoid attacks, but just as a signal of strength, and therefore, they may not be used and still serve a precautionary purpose. In what follows we describe the variables used to proxy each of this motives for reserves accumulation, and other controls such as the opportunity cost of holding reserves and the exchange rate regime.

The mercantilist motive is gauged through two components. The first one is the traditional approach, by which a country accumulates international reserves as a by-product of an export-led growth strategy, which relies on sterilized interventions to limit appreciation in order to defend trade competitiveness (Ghosh et al. 2017). As argued before, using exchange rate undervaluation as a measure of the mercantilist model has, beyond endogeneity issues, the problem that it would need the additional unwarranted assumption that higher levels of reserves result also in more depreciated currencies. However, central banks often decide to accumulate reserves when the currency seems to be overvalued. Consequently, we use a different variable from the normally used to proxy this approach. This variable is economic growth, and we use it because it allows us to distinguish in a more accurate way the incentive to delay a real appreciation which could harm competitiveness in the productive sector of countries with higher economic growth than trade competitors. This variable is lagged one year to avoid endogeneity issues and to account for the sluggish adjustment in the real sector.

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[12] This methodology has been proposed by Bertrand et al. (2004). They show that using an arbitrary variance-covariance matrix allows to deal with serial correlation within countries over time.

[13] Trend-GDP is computed through a constant growth rate in each country. The growth rate is: $g = \left(\frac{\text{GDP}_{t+T}}{\text{GDP}_t}\right)^{(1/T)} - 1$, where, for consistency, GDP_t is measured in current dollars.

In addition, the mercantilist motive also relates to the accumulation of reserves to mitigate exchange rate pressures when facing an improvement in the terms of trade. Accordingly, we consider the level of the *ToT* to be another variable to measure mercantilism. An improvement in the *ToT* should lead to a real appreciation (e.g. De Gregorio and Wolf 1994), and hence domestic authorities will have an incentive to accumulate reserves in order to mitigate the appreciation.[14] Foreign intervention should have heterogeneous effects across countries, due to their exposure to foreign trade, deepness of domestic financial markets, and other factors, and therefore using exchange rate undervaluation does not seem an appropriate proxy for mercantilism. In addition, the effects of reserve accumulation on the exchange rate depend also on whether its monetary effects are sterilized or not.

Nevertheless, all countries facing terms of trade gains will face pressures for appreciation of their currencies. For this reason, we think that it is better to look at *ToT* to estimate the mercantilist motive rather than the exchange rate. In addition, if the exchange rate is strong due to an improvement in the terms of trade, an additional incentive for intervention is precisely that foreign currency is relatively cheaper. Therefore, high *ToT* justifies the accumulation of reserves when there are competitiveness concerns. The period under analysis is particularly useful to test this approach because of the boom in commodity prices.

It could also be argued that periods of high *ToT* provide an opportunity to accumulate reserves for precautionary reasons. Therefore, it is self-insurance rather than mercantilism what would be behind the accumulation of reserves by commodity exporters. We address this issue below by including some interaction effects, and conclude that most of the *ToT* effect is due to mercantilism, not precautionary self-insurance.

International reserves may also serve as a *speculation deterrent*. Having high levels of reserves prevents speculators from attacking the currency. This is also consistent with the idea that international reserves are not necessarily used. They are usually in excess of what would be needed for capital flows volatility, but they still provide benefits on the side of financial stability. Weaknesses from the point of views of agents willing to attack an overvalued currency depend on the relative financial strength across countries. And the level of international reserves is a good indicator of financial strength, in particular the ability to provide foreign exchange liquidity. International reserves represent the war chest that authorities have to prevent an unwarranted currency attack.[15] Therefore, this motive for reserve accumulation can be captured by the relative standings of the country's reserve level as compared with other countries. This has been called the *Joneses effect*, by which the average level of reserves of other countries is a determinant of the own level of reserves.[16] But the origin of this Joneses effect is not to fall behind in terms of reserves compared to other

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[14] Aizenman and Riera-Crichton (2008) find that this mitigating effect of the accumulation of reserves is relevant in developing economies. For the effects of intervention see, for example, Kamil (2008), Adler and Tovar (2011), and Contreras et al. (2013).

[15] This point is also supported by Bussière et al. (2015) who see international reserves as a "nuclear weapon" having a deterrent effect, as opposed to "gunpowder" to be actively used. This deterrent effect is consistent with second-generation models of currency crises (see Obstfeld 1986).

[16] See Cheung and Qian (2009), Cheung and Sengupta (2011) and Aizenman et al. (2015).

countries to reduce vulnerability to currency attacks, because in this case the demand for reserves depends on the other countries' reserves holdings, which we also call *comparative hoarding.* It is important to note that this motive for reserve accumulation may lead to an excessive global level of international reserves. The variable *comparative hoarding* is measured as follows:[17]

$$Comparative\ hoarding_{it} = \frac{1}{N-1} \sum_{k \neq i} \frac{IR_{kt}}{GDP_{kt}}$$

In addition to this deterrent effect, the precautionary motive to hold reserves is a form of self-insurance against the financial impact of foreign turbulences, such as sudden stops, capital flights, or other external turmoil. The source of the turbulence could come from the current or the financial accounts. Regarding current account variables, we use the ratio of imports to GDP, the volatility of trade partners' growth and the volatility of the ratio of exports to GDP.[18] Regarding financial account variables, we use standard measures of reserve adequacy such as M2 over GDP and short-term debt as a share of GDP.[19] We also include the degree of openness of the financial account. We expect that an increase in all the variables related to the current account and the financial account will increase the level of reserves.

Moreover, we include the cost of holding reserves as the difference between the US and the local interest rates.[20] Finally, we include variables associated with the exchange rate regime. We use two alternatives. The first one is a *de jure* measure that assigns 1 to countries with a fixed exchange rate and 0 otherwise. The second measure is the volatility of the nominal exchange rate. It is supposed that countries with more rigid exchange rate regimes require higher levels of reserves to manage the exchange rate, in the extreme the fixed parity. In the other extreme, one could assume that countries with floating exchange rates would not need to hold reserves, since this would also make floating more credible. However, among emerging markets, countries hold reserves regardless of the exchange rate regime in place, and our research attempts to see if there are any significant differences across different exchange rate regimes.

Our sample consists of 52 developing and emerging market economies with per capita income between US\$ 3,000 and 20,000 in 2011 and which had all data available. Commodity exporting countries are those where over 70 percent of their total exports in 2008 corresponded to minerals, fuels or agricultural. Most of the data come from the World Bank and the International Monetary Fund (IMF), and the appendix provides details on the data used and countries included in the sample.

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[17] As a robustness check we also measure this variable using the smaller sample of developing countries.

[18] IMF (2003) pioneered the idea that volatility of exports is a good proxy for volatility of the current account.

[19] Obstfeld et. al. (2010) show evidence that the size of domestic financial liabilities (M2) is an important predictor of the reserve holdings. On the other hand, De Beaufort et. al. (2001) propose maintaining reserves in such a level that fully cover short term external debt.

[20] This variable has been used in most of the empirical work starting with the initial work of Edwards (1985).

3.2   Regression results

The main results are presented in table 1. We start by showing the results for the entire period 2000-2013, including first each of the different motives for accumulation separately in the regression, and then all of them together. In regression (1) we include the mercantilist motive proxied by *ToT* and *GDP growth lagged one year*. Later, in regression (2) we include only *comparative hoarding*, and then in regression (3) we include only the current and financial accounts variables that are used to proxy for *self-insurance*.

VARIABLES	(1) Mercantilist 2000-13	(2) Deterrent 2000-13	(3) Self-insurance 2000-13	(4) Baseline 2000-13	(5) Interactive 2000-13	(6) Baseline 2000-08	(7) Baseline 2009-13
Mercantilist							
TOT	0.0077**			0.0038	0.0034	0.0061**	-0.0006
	(0.0033)			(0.0031)	(0.0032)	(0.0026)	(0.0022)
L1. GDP growth	0.0047			0.0099***	0.0062*	0.0007	0.0004
	(0.0031)			(0.0028)	(0.0034)	(0.0057)	(0.0035)
Precautionary: deterrent							
comparative h.		1.2029***		0.7283***	0.9408***	0.3994*	-0.2874
		(0.1852)		(0.1552)	(0.2049)	(0.2176)	(0.3586)
Precautionary: self-insurance, current ac.							
ln(imports to GDP)			-0.2360	-0.2622	-0.2886	-0.1183	-0.4357
			(0.1812)	(0.2070)	(0.2127)	(0.1773)	(0.3175)
Vol. partner growth			0.0325**	0.0093	0.0221*	-0.0073	0.0409**
			(0.0131)	(0.0117)	(0.0129)	(0.0148)	(0.0156)
Vol. of exports/GDP			-0.8836	-0.2642	-0.1885	-0.5239	-0.3753
			(0.6217)	(0.3631)	(0.3668)	(0.4650)	(1.1744)
Precautionary: self-insurance, financial ac.							
ln(broad money to GDP)			0.8830***	0.3927**	0.4336**	0.4056**	0.3830
			(0.1999)	(0.1701)	(0.1709)	(0.1813)	(0.2481)
Short term debt to GDP			0.3324	0.2357	0.2491	-0.6621	0.2907
			(0.7980)	(0.5615)	(0.5749)	(0.6462)	(0.2988)
Financial openness			0.1140*	0.1003	0.0903	0.0221	0.1086
			(0.0635)	(0.0744)	(0.0724)	(0.0477)	(0.0702)
Oportunity cost							
Interest rate diff w/US	-2.4331***	-2.1937***	-2.7866***	-1.9822***	-1.7903***	-1.9130***	0.4156
	(0.4986)	(0.6111)	(0.5944)	(0.4855)	(0.5191)	(0.3851)	(1.5014)
Exchange rate regime							
Soft peg dummy	-0.1932	-0.1338	-0.2260**	-0.1687**	-0.2093**	-0.0610	-0.1966*
	(0.1373)	(0.0966)	(0.1003)	(0.0838)	(0.0936)	(0.0915)	(0.0995)
Vol. of NEER	0.0000*	0.0000**	0.0000*	0.0001**	0.0001**	0.0001***	0.0067
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0082)
Interactive term							
TOT*1{t≤2008}					0.0014**		
					(0.0007)		
Constant	-2.5725***	0.7120*	-1.2660***	-0.6993*	-0.2903	-1.5452***	-2.4128***
	(0.3946)	(0.3845)	(0.2981)	(0.4153)	(0.5195)	(0.5056)	(0.7565)
Observations	688	688	688	688	688	460	228
Number of countries	52	52	52	52	52	52	51
R-squared	0.223	0.316	0.291	0.395	0.405	0.384	0.188
Adjusted R-squared	0.218	0.312	0.282	0.385	0.394	0.367	0.143

Table 1. Determinants of international reserves.
Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses are clustered by country. The dependent variable used in all estimates from here on corresponds to the international reserves to trend GDP ratio. The GDP growth variable is lagged one year.

When included separately, there is evidence of mercantilism, self-insurance and deterrent. The same occurs after including all variables altogether (baseline regression (4)). However, in the mercantilist motive only GDP growth is significant, while *ToT* is not significant. This may

be because there is a bias due to omitted variables. Thus, the estimated coefficients for the mercantilist motive are unstable and there is no conclusive evidence for the entire period. In all of these regressions the opportunity cost of holding reserves is significant.

The reason why *ToT* is not significant for the entire period is that after the crisis the terms of trade were volatile with no clear trend. Therefore, it is not a good variable to separate countries that had more or less incentives to follow mercantilism through the accumulation of reserves for the entire period.[21] Indeed, regression (5) shows that when adding a dummy to split 2000-2008 from 2009-2013 the *ToT* variable is significant only in the first period, which corresponds to the commodity price boom.

The regression for the entire period however is not stable. Previous research has shown that the motives to accumulate reserves are not stable over time (see Delatte and Fouquau 2011; Ghosh et al. 2017; Aizenman et al. 2015). In particular, it is the existence of extreme events where stability breaks down, such as during the global financial crisis (Cheung and Ito 2009). For this reason, we split our estimations into two periods, 2000-2008 and 2009-2013. There is a structural break between the periods 2000-2008 and 2009-2013.[22]

The result of the baseline regression for the period 2000-2008 is presented in equation (6). The parameter for our variable representing the mercantilist motive, *ToT*, is positive and statistically significant. As terms of trade improve, the holdings of international reserves increase, consistent with our presumptions. In this shorter period, the other variable that has been used traditionally to measure mercantilism, GDP growth, is no longer significant. It is interesting that the two variables used to measure mercantilism are not simultaneously significant in these periods. However, as shown in (5), GDP growth lagged one year is significant for the entire period, and the terms of trade are relevant in 2000-2008, thus clearly this latter variable predominates in the period before the global financial crisis, which corresponds to the commodity price boom.[23]

Moreover, as a robustness check, we estimate the mercantilist motive with another variable that the literature has traditionally used, deviations from the "fundamental" PPP real exchange rate value (see Aizenman and Lee 2007; Delatte and Fouquau 2011). Our robustness results indicate that this variable doesn't affect reserves in the period 2000-2008 (see appendix table 8, column (3) for this robustness result). This should not be surprising, since as we argued above, we think this variable do not appropriately measure mercantilism since it

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[21] It has to be noted that the TOT variable was considered by Aizenman and Lee (2007) as a determinant for international reserves in the period 1980-2000. However, they find that in that case (previous to Asian Crisis) it's not a significant in emerging countries.

[22] We test the existence of a structural break in the regression coefficients in 2008 through a Chow test to pooled data (see Wooldridge 2016). Our estimations confirm that effectively there is a break in 2008.

[23] As robustness check, we consider an alternative scaling variable -broad money (M2)- used by Obstfeld et al. (2010), and we exclude small states with population below one million (Belize, Cape Verde, Dominica, Fiji, Grenada, Samoa, Seychelles, Saint Lucia, Saint Vincent and the Grenadines). In both of these cases the possitive ToT's effect remains significant in 2000-2008. See appendix table 7 for the complete list of countries and table 8, column (1) and (2) for robustness regression results.

depends on the ability of reserves accumulation to affect the exchange rate, which is certainly heterogeneous across countries. Finally, many times countries start intervening when the currency is overvalued, not undervalued.

An increase in the reserves holdings of other countries also increases the level of reserves, consistent with the idea that more reserves are needed to deter currency speculation.[24] Pre-financial crisis, an increase of one standard deviation in other countries' reserves (about 2 percent of GDP), as a fraction of GDP, led to an increase of about 6 percent in international reserves (column (6)).This finding is in line with Cheung and Qian (2009), Cheung and Sengupta (2011) and Aizenman et al. (2015), for different samples of countries and periods. Regarding the current and financial account variables, to capture the self-insurance motive, M2 over GDP has a positive and significant coefficient. This positive relationship has also been documented by Obstfeld et al. (2010) and Ghosh et al. (2017)[25]. The remaining variables of the self-insurance are not significant.[26]

As in the entire period, the opportunity cost of holding reserves affects negatively reserves holdings. Volatility of the exchange rate may indicate a more flexible exchange rate regime, and hence we would expect demand for reserves to decline. In contrast, our results show that volatility increases demand for reserves, and this could be related to higher uncertainty and the need for more self-insurance rather than to the flexibility of the exchange rate regime. However, this result is not robust to the elimination of outliers, in which case the parameter becomes insignificant.[27] The exchange rate regime indicator is not significant, except in equation (7), which will be discussed below.

Regarding the use of country fixed effects we conducted an F-test for the joint significance of the country-specific parameters (Baltagi 2013). The result of this test confirms our empirical specification, which includes country fixed effects.[28] In sum, our results for the period 2000-2008, characterized by a significant commodity price boom, indicate that there are mercantilist as well as precautionary reasons to accumulate reserves. In particular, the variable *ToT* for the mercantilist motive, *comparative hoarding* and M2 over GDP for the precautionary motive.

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[24] In addition, we construct the comparative hoarding variable weighted by distance of each country and the results remain the same (see appendix table 8, column (4) for robustness regression results). However, it is not obvious that the geographic distance will be relevant for a currency attack in a world where distance is not relevant for integrated financial markets.

[25] We have to point out that concerns about endogeneity of the broad money have been assessed by Ghosh et al. (2017) and Obstfeld et al. (2010). In similar especifications than ours they show that potential endogeneity doesn't affect their main results.

[26] This limited significance in some variables of the precautionary motive has also been observed by Ghosh et al. (2017) in 1998-2004 and in 2005-2010 for the volatility of the exports to GDP ratio and volatility of the trade partners' growth, Aizenman et al. (2015) in 1999-2006 do not find effects for financial openness, and Obstfeld et al. (2010) in 1980-2004 do not identify an impact for the short term debt to GDP ratio.

[27] See appendix table 8, column 5 for robustness regression result.

[28] The positive terms of trade's effect is robust to the inclusion of time fixed effects in the Mercantilist specification for period 2000-2008 (see appendix table 8, column (6) for robustness regression result).

Finally, column (7) presents the results of the baseline equation (1) for the period 2009-2013. These results are quite different from those of the 2000-2008 period. Only the volatility of trading partners' output and the indicator for fixed exchange rate regime turn out to have significant effects on the demand for reserves. Greater output volatility after the crisis may have led countries facing more volatility to keep relatively higher levels of reserves. In contrast, the negative sign on the fixed exchange rate dummy reveals that countries with fixed exchange rates reduced reserves holdings to maintain the parity of the currency. This effect was intense and offset other motives, such as mercantilism that is no longer relevant in this period. Indeed, the level of reserves for this group of countries started to decline in 2009, matching countries with more flexible regimes in 2013 (figure 4).[29] In this period, as discussed above, the *ToT* variable is not a significant determinant of demand for reserves and the explanatory power of the regression also declines.
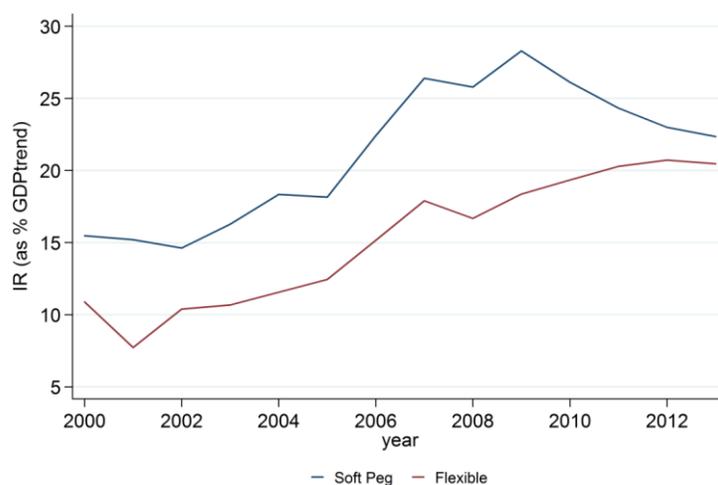
Figure 4. International reserves as percentage of trend GDP by exchange rate regime. Emerging and developing countries, 2000-2013.
Sources: WDI-World Bank and IMF.

4.   Robustness checks and decomposition

4.1   Robustness of terms of trade and the mercantilist motive

In the previous section we showed that during 2000-2008 countries that faced increasing terms of trade accumulated higher levels of international reserves. We have considered this as an indication of mercantilism. However, it could be argued that improving the terms of trade also provides a good opportunity to accumulate reserves for precautionary reasons. Indeed, as governments accumulate sovereign wealth funds (SWF) as self-insurance for public finance

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[29] It is important to note that most countries considered in our database have soft peg exchange rate regimes (37 out of 52 countries in year 2009) and these countries decreased reserves after the global financial crisis. Particularly, this factor was quite relevant among commodity exporting countries (13 out of 16 countries with soft peg in 2009). In contrast, countries with flexible exchange rate regimes continued hoarding reserves after the crisis.

reasons when the external environment is positive, improving terms of trade may incentivize reserves accumulation. We identify empirically two cases in which this could apply.

First, high terms of trade volatility induces greater volatility in the current account, and consequently more international financial needs. For this reason, a country may accumulate reserves when terms of trade are improving for self-insurance reasons.[30] In this case we include the volatility of terms of trade as an explanatory variable, jointly with their level. The second case is to consider that reserve accumulation due to self-insurance is easier to undertake when terms of trade improve. In this case, we include interaction effects of the current and financial account variables, used to proxy for self-insurance, with terms of trade. Thus, we include in the baseline regression interactions of terms of trade and the ratios of imports, M2 and short term debt to GDP, as well as the index of financial openness.

The results are presented in table 2. For the first case, as shown in columns (1) and (2), the volatility of ToT, computed for 3- and 5-year periods, has no effects on the demand for reserves.[31] For the interaction effects, the result in column (3) shows no effect of the interaction between ToT and imports to GDP. For the other variables: M2 and short term debt over GDP, and financial opening, the results in columns (4) to (6) show that the sign of the interaction effect is the opposite of the expected one. That is, an improvement in the terms of trade would reduce the intensity of the accumulation of reserves for precautionary reasons. In all of these cases, the variable ToT has a positive sign, and only when interacted with imports to GDP it is not significantly different from zero. These results imply that the self-insurance reason to accumulate reserves would be reduced in times of high terms of trade. Therefore, the results of these regressions show no evidence that the positive impact of an improvement in ToT on the level of reserves is due to greater intensity of the precautionary motive.

Overall, we do not find evidence that the positive effect of ToT on international reserves is due to the precautionary motive. Given that pressures on the exchange rate increased with improvements in ToT, our results confirm that the effects of this variable are coming mostly from a mercantilist reason. This motive would pursue to mitigate the strengthening of the currency. Figure 5 shows the sharp increase in the terms of trade for commodity exporters, as well as the significant real appreciation. The appreciation was more limited for non-commodity exporters.

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[30] As Aizenman et al. (2015) indicates the introduction of a sovereign wealth fund may reduce the exclusivity of international reserve as the main financial buffer, indeed their results indicate that it affects negatively the hoarding in developing countries in 1999-2012. We find similar results when we incorporate SWF as a determinant for international reserves in 2000-2013 (see table 8, column 7).

[31] The result that volatility of TOT doesn't affect international reserves is robust to the incorporation of a banking crises variable in period 2000-2008. The inclusion of a banking crisis variable was considered by Aizenman et al. (2015). In a similar manner than our estimations for 2000-2008, they show that this is not relevant in 1999-2006 (see table 8, columns 8-10).

VARIABLES	(1) vol. TOT (3 years)	(2) vol. TOT (5 years)	(3) TOT* (M/GDP)	(4) TOT* (M2/GDP)	(5) TOT* (STD/GDP)	(6) TOT*Fin. Openess
Mercantilist						
TOT	0.0049**	0.0080**	0.0011	0.0120**	0.0075***	0.0044**
	(0.0022)	(0.0037)	(0.0037)	(0.0045)	(0.0025)	(0.0019)
L1. GDP growth	0.0011	0.0009	0.0008	-0.0039	0.0006	-0.0005
	(0.0057)	(0.0055)	(0.0055)	(0.0060)	(0.0056)	(0.0056)
Precautionary: deterrent						
Comparative h.	0.4884**	0.4760**	0.4976**	0.4050*	0.3672	0.4863**
	(0.2211)	(0.2188)	(0.2294)	(0.2117)	(0.2205)	(0.2106)
Precautionary: self-insurance, current ac.						
ln(imports to GDP)	-0.1214	-0.1385	-0.8148	0.0280	-0.1014	-0.0969
	(0.1675)	(0.1725)	(0.6380)	(0.1801)	(0.1721)	(0.1787)
Vol. partner growth	-0.0064	-0.0113	-0.0056	-0.0052	-0.0128	-0.0109
	(0.0146)	(0.0164)	(0.0148)	(0.0141)	(0.0158)	(0.0147)
Vol. of exports/GDP	-0.5558	-0.4350	-0.6079	-0.4456	-0.4707	-0.3431
	(0.4812)	(0.4014)	(0.4598)	(0.4484)	(0.4453)	(0.4156)
Precautionary: self-insurance, financial ac.						
ln(broad money to GDP)	0.3145	0.3370*	0.3579**	0.9528***	0.4602**	0.3161*
	(0.1895)	(0.1891)	(0.1780)	(0.3344)	(0.1816)	(0.1638)
Short term debt to GDP	-0.8407	-0.7594	-0.5824	-0.7469	2.0206	-0.6188
	(0.7040)	(0.6309)	(0.4970)	(0.4922)	(1.4948)	(0.5372)
Financial openness	0.0166	0.0210	0.0114	0.0426	0.0246	0.3759***
	(0.0476)	(0.0492)	(0.0428)	(0.0477)	(0.0454)	(0.1294)
Oportunity cost						
Interest rate diff w/US	-1.7872***	-1.8429***	-1.9223***	-1.7205***	-1.9224***	-1.7128***
	(0.3879)	(0.3860)	(0.3885)	(0.3583)	(0.3744)	(0.3464)
Exchange rate regime						
Soft peg dummy	-0.0778	-0.0813	-0.0588	-0.0989	-0.0671	-0.0400
	(0.0932)	(0.0981)	(0.0821)	(0.0933)	(0.0931)	(0.0902)
Vol. of NEER	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Robustness TOT						
Vol. TOT (3-year sd)	0.0078					
	(0.0067)					
Vol. TOT (5-year sd)		-0.0082				
		(0.0096)				
TOT * imports to GDP			0.0149			
			(0.0117)			
TOT * broad money to GDP				-0.0164**		
				(0.0081)		
TOT * Short term debt to GDP					-0.0305*	
					(0.0165)	
TOT * Financial openness						-0.0033***
						(0.0012)
Constant	-1.3346**	-1.5846***	-2.2231***	-0.6468	-1.6473***	-1.2750**
	(0.5234)	(0.5625)	(0.7862)	(0.5734)	(0.5076)	(0.4940)
Observations	442	442	460	460	460	460
Number of countries	52	52	52	52	52	52
R-squared	0.388	0.387	0.398	0.422	0.390	0.419
Adjusted R-squared	0.369	0.368	0.381	0.405	0.373	0.402

Table 2. Robustness of terms of trade as Mercantilist Motive (2000-2008).
Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses are clustered by country.
Every estimate corresponds to Baseline model plus robustness variables. The GDP growth variable is lagged one year.
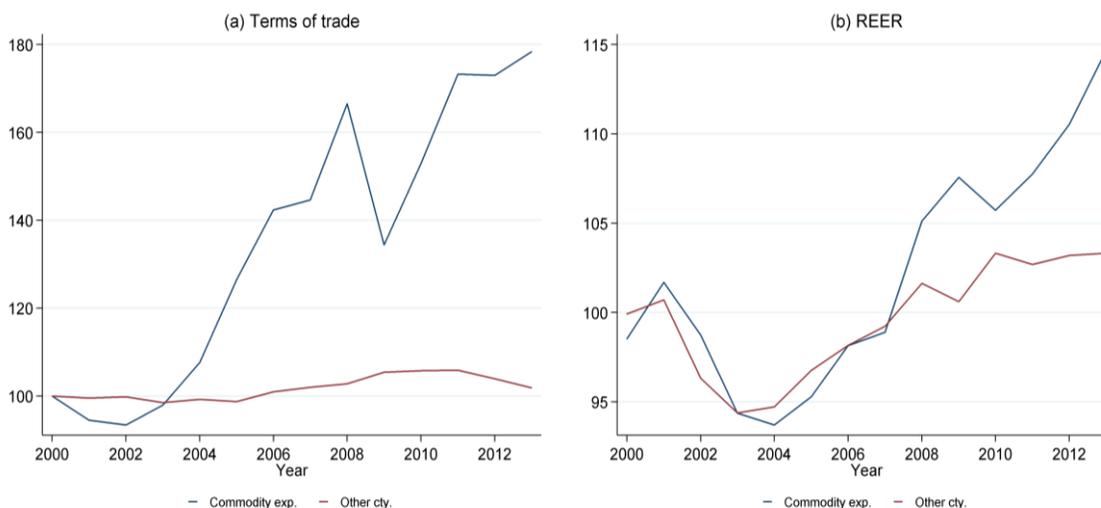
Figure 5. Evolution of terms of trade and real effective exchange rate. Emerging and developing countries, 2000-2013.
Note: The Real effective exchange rate (REER) is measured as units of foreign goods per unit of domestic goods and, hence, an upward movement reflects a real exchange rate appreciation.
Sources: WDI-World Bank and Darvas (2012), index 2000=100 for terms of trade and index 2007=100 for REER.

4.2   Decomposition of reserve accumulation: the relevance of different factors

Our results support the view that during the massive process of reserve accumulation previous to the global financial crisis there were mercantilist, self-insurance and speculation deterrent reasons for it. In this section we present a decomposition to evaluate the relative importance of the different motives behind reserve hoardings.

First, we use our baseline estimation to decompose the evolution of international reserves during the period 2000-2008. The result of this decomposition is presented in figure 6. At the beginning of the decade, just when countries were coming out of the Asian crisis, the precautionary effect reached its maximum explanatory power. The crisis was characterized by sudden stops, financial turbulences and contagion. One of the main policy conclusions was the need to have an adequate level of international reserves to be well prepared to withstand international financial shocks, which by the late 1990s were deemed to be insufficient. The *comparative hoarding* (deterrent) was also important. The decision of some countries to accumulate reserves induced a spiral of accumulation, since there is comparative hoarding, to signal financial strength. At the beginning and the end of the period the comparative deterrent motive was quite important. At the end of the period 2000-2008, and as a consequence of the increasing price of commodities, the mercantilist motive had preeminence.[32] The other factors, such as the opportunity cost of holding reserves, the exchange rate regime and country fixed factors played always a relevant role.

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[32] Notice that in the period 2000-2008 the traditional approach of the mercantilist motive measured as GDP growth lagged is not statistically significant (see column 6 table 1). Thus, the result observed at the end of the period 2000-2008 is mainly motivated by terms of trade gain.

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It is important to note that the early 2000s was a period of moderate reserve accumulation (figure 1), and the accumulation accelerated toward the mid of the decade. As figure 6 shows, during this period the mercantilist and comparative motives were the main factors explaining this process.

We also decompose the R-squared of the baseline regression, distinguishing among mercantilist, self-insurance, deterrent, and other. The result of this decomposition is in table 3, where we see that more than a third is explained by the mercantilist motive and is the most important factor explaining the R-squared, and its explanatory power is about the same as the comparative and self-insurance motives combined.
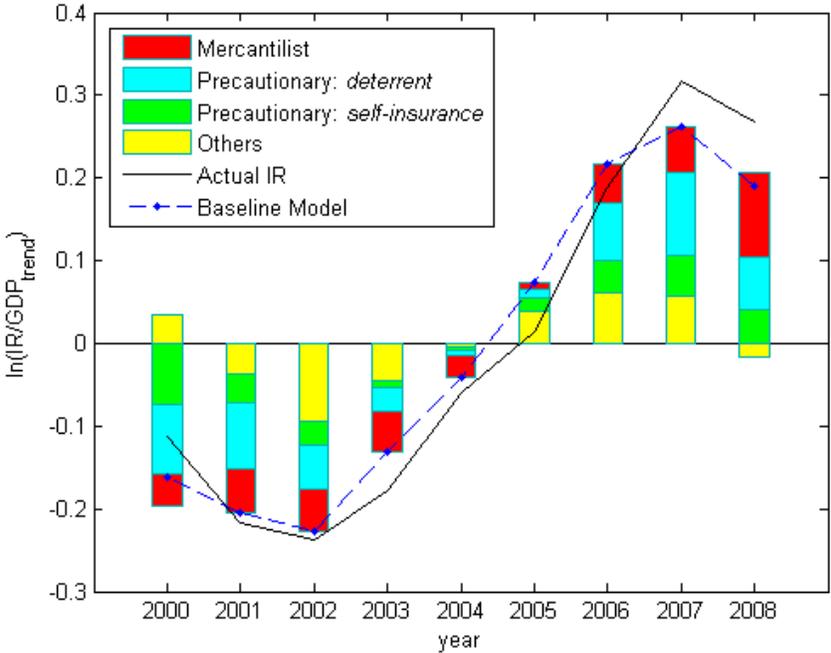
Figure 6. Prediction produced by the Baseline model for each motive for maintaining international reserves. Emerging and developing countries, 2000-2008.
Note: These results are presented in logarithmic terms, which is why there are negative observations. The solid black line shows the international reserves-to-observed trend GDP ratio. The blue dotted line shows the prediction produced by the Baseline model. In absolute terms, the size of the color in each bar indicates the estimations generated by each motive. The vertical sum of these four bars in each year produces the Baseline prediction (dotted blue line) for that year as a result. The results are found in deviations from the average (this transformation eliminates the fixed effects by country, which can be recovered algebraically).
Source: Authors' calculations based on estimation presented in table 1, column (6).

	R-squared	% of R-squared
Mercantilist	14,4	37,5
Precautionary: deterrent	6,7	17,4
Precautionary: self-insurance	8,2	21,4
Other variables	9,1	23,8
Total R-squared	38,4	100,0

Table 3. R-squared, decomposed according to motives for maintaining international reserves (2000-2008).
Note: The rows "Mercantilist", "Precautionary: deterrent" and "Precautionary: self-insurance" show the proportion of the R-squared of the Baseline estimate that corresponds to the mercantilist motive, comparative hoarding and current and financial account shocks, respectively. The row "Other variables" corresponds to the portion of the Baseline estimate's R-squared that is related to the control variables. Lastly, the sum of the rows corresponds to the Baseline estimate's R-squared for all countries. The R-squared is decomposed using:

$$R^2 = \frac{SSR}{SST} = \frac{b'X'M^D X b}{Y'M^D Y} = \frac{b'X'M^D (M^D X_M b_M + M^D X_{Pd} b_{Pd} + M^D X_{Ps} b_{Ps} + M^D X_o b_o)}{Y'M^D Y}$$

where M^D transforms each variable with respect to its mean, and by construction the components add up to 100 percent.
Source: Authors' calculations based on regression (6), table 1.

Finally, an additional exercise we perform is to split the sample between commodity and non-commodity exporters. For short, we call them commodity exporters and others. We estimate our baseline regression for these two groups of countries during the period 2000-2008. We have argued in this paper that the relevance of commodities in the export basket was relevant in the decision of increasing reserves holdings to mitigate the appreciation of the currencies in the presence of rising terms of trade. For commodity exporters the terms of trade increased about 65 percent between 2000 and 2008 while for other countries this increase was only 4 percent. The results are presented in table 4 and the contrast in the two groups is quite striking.

In the sample of commodity exporters the regression shows that the higher the terms of trade, the higher the accumulation of international reserves. There is no evidence of precautionary motive among these countries. We have the counterintuitive result that higher volatility of exports results in less reserves. However, once we exclude extreme observations, in particular the first and 99th percentile, this variable loses significance (see appendix table 8, column 11 for this robustness result).

On the other hand, in the sample of other countries terms of trade as well as variables associated with the precautionary motive coming from the current as well as the financial accounts are not significant. *Comparative hoarding* and the opportunity cost of holding

VARIABLES	(1) Commodity exporters	(2) Other countries
Mercantilist		
TOT	0.0093**	0.0025
	(0.0035)	(0.0032)
L1. GDP growth	-0.0058	0.0079
	(0.0084)	(0.0058)
Precautionary: deterrent		
comparative h.	-0.2984	0.6361***
	(0.2057)	(0.2086)
Precautionary: self-insurance, current ac.		
ln(imports to GDP)	-0.3626	0.0032
	(0.3040)	(0.2171)
Vol. partner growth	-0.1065	0.0024
	(0.0802)	(0.0151)
Vol. of exports/GDP	-2.6937**	-0.0465
	(1.0576)	(0.2971)
Precautionary: self-insurance, financial ac.		
ln(broad money to GDP)	-0.0632	0.3524
	(0.4309)	(0.2137)
Short term debt to GDP	-1.3296	0.0250
	(1.4110)	(0.3767)
Financial openness	-0.0003	0.0188
	(0.0884)	(0.0550)
Oportunity cost		
Interest rate diff w/US	-2.6706***	-1.3937***
	(0.4748)	(0.5068)
Exchange rate regime		
Soft peg dummy	0.0971	-0.1150
	(0.2015)	(0.0878)
Vol. of NEER	0.0001***	0.0001
	(0.0000)	(0.0001)
Constant	-4.1699***	-0.6517
	(0.7463)	(0.6206)
Observations	144	316
Number of countries	16	36
R-squared	0.463	0.388
Adjusted R-squared	0.414	0.364

Table 4. Determinant of international reserves by group of countries (2000-2008).
Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses are clustered by country. The GDP growth variable is lagged one year.

reserves are the only two determinants of reserve accumulation.[33] These countries accumulated reserves in parallel with the remaining countries and this responded to the need to have reserves comparable with other countries that were accumulating for mercantilist reasons in order to avoid being identified as financially vulnerable.

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[33] Ghosh et al. (2017) find little evidence supporting the hypothesis that mercantilist motive is stronger in countries with higher share of manufacturing exports. This result is consistent with our finding in the group other countries.

Therefore, the results of our decomposition confirm the relevance of mercantilism in the period of large reserves accumulation, which induced countries that are not commodity exporters to accumulate reserves in order to "keep up with the Joneses."

5. Concluding remarks

This paper has shown a complementary way to estimate the mercantilist motive through the terms of trade. Traditionally, this has been estimated using exchange rate undervaluation. However, that strategy has the implicit assumption that foreign exchange intervention is effective and ignores that in many occasions reserves accumulation is initiated when the currency is strong, more likely overvalued.

In addition, we integrate our approach with a more general view of the precautionary motive. Traditionally, the precautionary motive has been associated with the volatility of external financing needs, but we also consider *comparative hoarding*, by which the accumulation of reserves is also induced by increasing reserves of other countries. Under financial turmoil, relative strength matters in terms of resilience.

The 2000s before the global financial crisis provides an appropriate period for our investigation since there was a significant commodity price boom that put strong pressures on the currencies of commodity exporting countries. This was also a period of the largest reserve accumulation. Policymakers, in particular in commodity exporting countries, tried to mitigate the effects of increasing terms of trade through the accumulation of reserves in order to limit the loss of competitiveness of their non-commodity export sector.

Our estimates confirm a positive relationship between the terms of trade and the maintenance of international reserves during the period 2000-2008. The statistical evidence shows that this positive relationship cannot be attributed to a precautionary motive, so the best explanation of this finding is that the increased maintenance of international reserves due to an improvement in the terms of trade responds to a mercantilist motive. There is also evidence of precautionary motive, and their explanatory power is similar to those of the mercantilist motive.

We do not find any effect of *ToT* on the international reserves in the period 2009-2013. Indeed, the estimates are much weaker during this latter period. The explanatory power declines and only the volatility of growth rate of trade partners is a significant determinant in our regressions. There has been change in patterns in the process of reserve accumulation. Aizenman et al. (2015) have argued that the application of macroprudential tools as well as the existence of sovereign wealth funds have reduced the needs for self-insurance through reserves. However, it is also likely that the accumulation before the global financial crisis was so important, in part due to *comparative hoarding*, that economies were over-insured, and

hence reserves were above their optimal levels. Indeed, most calibrations of optimal level of reserves yield levels much lower than the peak reached in the late 2000s.[34]

An intense debate in policy circles has been about the accumulation of reserves as currency manipulation, and indeed the mercantilist motive is precisely an attempt to protect competitiveness. However, as this paper shows, during the buildup of reserves in the 2000s all the motives were present and hence it is very difficult to disentangle them for policy and global coordination purposes. In addition, the effectiveness of reserves accumulation to affect the value of the currency is heterogeneous across countries.

Finally, the accumulation of reserves in the presence of *comparative hoarding* can generate inefficiencies. Indeed, the accumulation of reserves in some countries may induce accumulation in others just in order to maintain relative vulnerabilities from the markets' point of view. This creates an inefficiency due to the lack of coordination. Precisely this may explain why reserves reached unprecedented levels in recent years. There could be scope for coordination, but it is not easy to implement. The creation of flexible liquidity facilities by the IMF could help. It serves the precautionary motive, but it ignores that simultaneously there could be a mercantilist motive, which can explain why just three countries have made use of this line.

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[34] IMF (2011) shows that in the late 2000s most of the emerging markets accumulated more reserves than suggested by standard rules of thumb, i.e. 3 months of imports, 100% of short term debt and 20% of broad money. Similarly, Dominguez et al. (2012) and Obstfeld et al. (2010) indicate that the accumulation of reserves in some emerging markets was excessive.

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Appendix A

Variable	Definition	Source
IR	International Reserves, without gold.	World Bank
GDP	Gross Domestic Product in current dollars.	World Bank
ToT	Terms of Trade ("Net Barter Terms of Trade"). Index base year 2000.	World Bank
GDP growth	Annual percentage growth rate of GDP.	World Bank
Comparative h.	Annual mean of natural logarithm of the reserves to observed GDP ratio without country 'i'	World Bank
ln(imports to GDP)	Natural Imports-to-GDP ratio logarithm.	World Bank, IMF
Vol. partner growth	Standard 3-year deviation from average growth of trading partners (countries which together represent over 70% of its exports in 2008, according to World Trade Organization, 2009).	World Trade Organization, IMF
Vol. of exports/GDP	Standard 3-year deviation from exports-to-GDP ratio.	World Bank, IMF
ln(broad money to GDP)	Natural logarithm of money and quasi-money measurement ratio M2-to-GDP.	World Bank
Short term debt to GDP	Short term debt, due in less than one year.	World Bank
Financial openness	Chinn Ito Index	Numbers updated through 2013
Interest rate diff. w/US	Interest rate differential compared to the United States, as appropriate (deposits, money market, treasury-bill rate or lending rate). Corresponds to: $\ln((1+i)/(1+i\_US))$	IMF-IFS
Soft peg dummy	Dummy variable that assigns a 1 to a fixed exchange rate, currency board arrangement, crawling peg, crawling band, and managed floating. With 0 otherwise.	Ilzetzki, Reinhart and Rogoff (2008), according to IMF classification
Vol. of NEER	Standard deviation of the nominal effective exchange rate in the last 36 months.	Darvas (2012)

Table 5. Variables used in the Baseline model.

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Dependent Variable					
IR to GDPtrend	460	0.157	0.144	0.000131	1.092
Mercantilist					
TOT	460	106.2	26.06	74.94	251.7
L1. GDP growth	460	5.092	4.669	-10.89	34.50
Precautionary: deterrent					
comparative h.	460	0.118	0.0192	0.0898	0.170
Precautionary: self-insurance, current ac.					
ln(imports to GDP)	460	0.459	0.209	0.000543	1.121
Vol. partner growth	460	1.322	1.203	0.0326	10.08
Vol. of exports/GDP	460	0.0330	0.0433	2.71e-05	0.666
Precautionary: self-insurance, financial ac.					
ln(broad money to GDP)	460	0.514	0.320	0.104	1.588
Short term debt to GDP	460	0.0884	0.113	0	0.871
Financial openness	460	0.152	1.453	-1.889	2.390
Oportunity cost					
Interest rate diff w/US	460	0.0446	0.0718	-0.0412	0.625
Exchange rate regime					
Soft peg dummy	460	0.822	0.383	0	1
Vol. of NEER	460	0.0724	0.921	0.000308	16.43

Table 6. Descriptive statistics of Baseline model (2000-2008).
Note: The variables used in natural logarithm in the estimates are expressed in exponential terms to be interpreted economically.

Commodity exporters (16 Countries)		Other Countries (36 Countries)		
		Albania	Dominica	Morocco
Algeria	Gabon	Argentina	Dominican	Peru
Angola	Kazakhstan	Armenia	Rep.	Samoa
Azerbaijan	Panama	Belarus	El Salvador	South Africa
Belize	Paraguay	Bosnia and	Georgia	Saint Lucia
Chile	Russian Federation	Herzegovina	Granada	Saint Vincent
Rep. Congo	Seychelles	Botswana	Guatemala	and the
Ecuador	Uruguay	Brazil	Indonesia	Grenadines
Fiji	Venezuela, BR	Bulgaria	Jordan	Swaziland
		Cape Verde	Latvia	Thailand
		China	Lithuania	Tunisia
		Colombia	Macedonia	Turkey
		Costa Rica	Malaysia	Ukraine
			Mexico	

Table 7. Sample of countries
Note: The countries used are those which had per capita incomes between US$ 3,000 and 20,000 in 2011 and which had data available for the research. Commodity exporting countries are those where over 70 percent of their total exports in 2008 corresponded to minerals, fuels or agricultural products (see World Trade Organization 2009). The group of other countries includes all those that are not considered commodity exporters.

VARIABLES	IR (%M2) (1) 2000-08	Small states (2) 2000-08	Traditional mercantilism (3) 2000-08	Distance weighted (4) 2000-08	Without extreme observations vol NEER (5) 2000-08	Time FE (6) 2000-08
Mercantilist						
TOT	0.0029**	0.0049**		0.0037**	0.0059**	0.0065**
	(0.0014)	(0.0023)		(0.0018)	(0.0027)	(0.0028)
GDP growth	-0.0003	-0.0023		-0.0005	-0.0001	-0.0048
	(0.0035)	(0.0062)		(0.0052)	(0.0052)	(0.0066)
Precautionary: deterrent						
Comparative h.	-0.1185	0.4955*	0.6529***		0.4261*	
	(0.1461)	(0.2622)	(0.2346)		(0.2125)	
Precautionary: self-insurance, current ac.						
ln(imports to GDP)	0.0552	-0.1915	-0.3228	-0.0147	-0.1175	
	(0.1048)	(0.1799)	(0.2063)	(0.1647)	(0.1801)	
Vol. partner growth	-0.0003	-0.0100	-0.0011	-0.0025	-0.0061	
	(0.0052)	(0.0165)	(0.0148)	(0.0145)	(0.0144)	
Vol. of exports/GDP	-0.2081	-0.2432	-0.5149	-0.4613	-0.4855	
	(0.1590)	(0.4145)	(0.5129)	(0.5166)	(0.4663)	
Precautionary: self-insurance, financial ac.						
ln(broad money to GDP)		0.5625**	0.5552***	0.4254***	0.4200**	
		(0.2477)	(0.1839)	(0.1546)	(0.1813)	
Short term debt to GDP	-0.4008	-2.3317	-0.9903	-0.6750	-0.6499	
	(0.4152)	(1.5042)	(0.9415)	(0.5311)	(0.6633)	
Financial openness	-0.0273	0.0181	0.0022	0.0276	0.0207	
	(0.0218)	(0.0497)	(0.0344)	(0.0443)	(0.0478)	
Oportunity cost						
Interest rate diff w/US	-0.5127**	-1.9120***	-2.1230***	-1.4672***	-1.8447***	-1.8823***
	(0.1953)	(0.4047)	(0.4627)	(0.4625)	(0.4458)	(0.4442)
Exchange rate regime						
Soft peg dummy	0.0266	-0.0764	-0.0473	-0.0309	-0.0495	-0.0553
	(0.0348)	(0.0993)	(0.0899)	(0.0959)	(0.0986)	(0.0856)
Vol. of NEER	0.0240***	0.0917***	0.0579*	0.0001***	-0.1073	0.0758***
	(0.0075)	(0.0158)	(0.0311)	(0.0000)	(1.8275)	(0.0122)
Others						
PLDE			-0.1140			
			(0.2338)			
Comparative h. (dist. weighted)				0.5510***		
				(0.1630)		
Constant	-0.0564	-0.9661*	-0.3909	-0.8287*	-1.4622***	-2.8607***
	(0.3390)	(0.5520)	(0.4803)	(0.4709)	(0.5119)	(0.2743)
Observations	460	381	460	460	450	460
Number of countries	52	43	52	52	0.370	52
R-squared	0.134	0.438	0.313	0.442	52	0.378
Adjusted R-squared	0.113	0.419	0.296	0.427	0.353	0.360

Table 8. Robustness results

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses are clustered by country. The dependent variable used in all estimates corresponds to the international reserves to trend GDP ratio, except column (1) that uses international reserves to broad money (M2) ratio. Column 2 excludes small states with population below one million (Belize, Cape Verde, Dominica, Fiji, Grenada, Samoa, Seychelles, Saint Lucia, Saint Vincent and the Grenadines). Variable PLDE in column (3) is deviations from the "fundamental" PPP real exchange rate value (defined as the fitted value from the regression of the national price levels to the PPP-based real per-capita income relative to the United States and time fixed effects. See Aizenman and Lee 2007; Delatte and Fouquau 2011). Column (4) incorporates comparative hoarding weighted the distance between each country. In column (5) we exclude percentile 1st and 99 st of the *vol. of NEER*. Finally, column (6) incorporates time fixed effects.

VARIABLES	Sovereign Wealth Fund (7) 2000-2013	Banking Crises (8) 2000-2008	Banking Crises (9) 2000-2008	Banking Crises (10) 2000-2008	Without extreme observations vol export/GDP (11) 2000-2008
Mercantilist					
TOT	0.0041	0.0062**	0.0048**	0.0080**	0.0092**
	(0.0032)	(0.0026)	(0.0023)	(0.0037)	-0.0034
GDP growth	0.0098***	0.0001	0.0003	0.0003	-0.0044
	(0.0028)	(0.0056)	(0.0056)	(0.0054)	-0.0077
Precautionary: deterrent					
Comparative h.	0.7280***	0.3891*	0.4785**	0.4666**	-0.5212
	(0.1558)	(0.2181)	(0.2218)	(0.2190)	-0.3621
Precautionary: self-insurance, current ac.					
ln(imports to GDP)	-0.2599	-0.1205	-0.1227	-0.1398	-0.3411
	(0.2099)	(0.1788)	(0.1692)	(0.1745)	-0.3155
Vol. partner growth	0.0083	-0.0085	-0.0072	-0.0121	-0.1131
	(0.0116)	(0.0150)	(0.0148)	(0.0167)	-0.0766
Vol. of exports/GDP	-0.2419	-0.4696	-0.4975	-0.3867	-3.352
	(0.3575)	(0.4392)	(0.4540)	(0.3779)	-2.2939
Precautionary: self-insurance, financial ac.					
ln(broad money to GDP)	0.3820**	0.4333**	0.3509*	0.3618*	-0.0273
	(0.1684)	(0.1774)	(0.1865)	(0.1845)	-0.4692
Short term debt to GDP	0.2283	-0.6425	-0.8238	-0.7436	-1.3793
	(0.5592)	(0.6431)	(0.7070)	(0.6314)	-1.551
Financial openness	0.1043	0.0179	0.0105	0.0172	0.0002
	(0.0743)	(0.0489)	(0.0487)	(0.0502)	-0.08
Oportunity cost					
Interest rate diff w/US	-1.9702***	-1.7837***	-1.6086***	-1.7243***	-2.5713***
	(0.4882)	(0.3808)	(0.3894)	(0.3799)	-0.4621
Exchange rate regime					
Soft peg dummy	-0.1715**	-0.0840	-0.1092	-0.1044	0.0414
	(0.0843)	(0.0867)	(0.0891)	(0.0921)	-0.2039
Vol. of NEER	0.0504**	0.0850***	0.0757***	0.0888***	0.1076***
	(0.0212)	(0.0144)	(0.0126)	(0.0150)	-0.0294
Others					
Sovereign Wealth Fund	-0.2076*				
	(0.1173)				
Banking crises		-0.1197	-0.1484	-0.1083	
		(0.1075)	(0.1023)	(0.1089)	
Vol. TOT (3-year sd)			0.0093		
			(0.0070)		
Vol. TOT (5-year sd)				-0.0078	
				(0.0097)	
Constant	-0.7275*	-1.5404***	-1.3004**	-1.5713***	-4.4988***
	(0.4258)	(0.5064)	(0.5251)	(0.5623)	-0.8113
Observations	688	460	442	442	141
Number of countries	52	52	52	52	16
R-squared	0.399	0.387	0.392	0.389	0.462
Adjusted R-squared	0.387	0.369	0.372	0.369	0.411

Table 8. Robustness results (*Continued*)
Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses are clustered by country. The dependent variable used in all estimates corresponds to the international reserves to trend GDP ratio. Column (7) incorporates a dummy variable considering countries with sovereign wealth fund, using data from SWF Institute. Columns (8), (9), and (10) incorporate Systemic Banking crises variable reported in Laeven and Valencia (2012). Finally, column (11) excludes percentile 1st and 99 st of *vol. of export/GDP*.