RedNIE

Red Nacional de Investigadores en Economía

DOCUMENTO DE TRABAJO 2020 - 07

How should Central Banks accumulate reserves?

Sturzenegger, Federico

Citar como:

Sturzenegger, Federico (2020).How should Central Banks accumulate reserves? Documentos de Trabajo RedNIE, 2020-7

How should Central Banks accumulate reserves?

Federico Sturzenegger
Universidad de San Andres*
Vito Dumas 284, Victoria, Buenos Aires, Argentina

Abstract

There has been substantial research on the benefits of accumulating foreign reserves, but less on the relative merits of how to finance those reserves. Does it matter if reserves are accumulated through unsterilized purchases, by issuing domestic currency liabilities or by issuing foreign currency liabilities? This paper explores this question by looking at the impact of different ways to finance reserve accumulation on country spreads. The results suggest that the financing source is not irrelevant. Accumulating reserves through unsterilized interventions or by issuing domestic debt, do reduce country risk. On the contrary accumulating reserves by issuing foreign liabilities seems not to have a meaningful effect.

*I thank Santiago Cesteros and Santiago Mosquera for able research assistance and Walter Sosa Escudero and Enrique Szewach for useful suggestions. Correspondence address: fsturzenegger@udesa.edu.ar

1 Introduction

There is an extensive literature on the benefits and costs of holding foreign reserves. The benefits associated to reserves hinge on three basic attributes: the role of reserves as a source of liquidity, their role as a hedging mechanism, and their use to smooth changes in the real exchange rate in what has been called the "mercantilistic" motive. The costs are associated to the financing costs of reserves including their impact on inflation if purchased through unsterilized interventions.

Traditionally the motivation for reserves has been that of providing a liquidity reservoir for times of need, in which reserves can be used to smooth balance of payments disruptions. Initially the focus was mostly associated to trade (reserves were calibrated in terms of months of imports) but more recently focused on capital flows. This second view was popularized in the so called Greenspan-Guidotti rule, a rule of thumb by which Central Banks should hold reserves equivalent to their short term liabilities (Greenspan, 1999). Ranciere and Jeanne (2006) formalized this financial approach in a framework that added both a negative output effect of capital flow reversals as well as a positive effect of reserve accumulation on spreads. They find that a model with these ingredients provides a rationale for levels of reserves consistent with those observed in most countries. After the great financial crisis many studies (see for example Dominguez et al. (2012) and Bussière et al. (2015)), showed that reserves allowed countries to face the financial crisis with lower output costs. Levy Yeyati (2008) documents the impact of reserves on spreads suggested in Jeanne and Ranciere. As a broad summary of these findings, in 2011, the IMF (2011) proposed a practitioner's guide to estimate optimal reserves where exposure to financial flow reversals (the amount of short term debt relative to M2) and trade flows were the main ingredients.

The hedging role of reserves was originally discussed in relation to the currency compo-

sition of reserves (see Dellas and Yoo (1991)), but was taken a step further by Caballero and Panageas (2003). Their idea is that government could aim at *improving* its income at times of distress by investing reserves in instruments that correlated negatively with its own shocks. A practitioners guide to implement this idea is discussed in Sturzenegger (2019), and Torriani and Vicens (2020).

Finally, the mercantilistic approach, was an attempt to explain the policy of central banks aimed at avoiding large exchange rate appreciations, a motivation that became prominent during the reserves buildups of the 2000s, and particularly by the presumption that China was accumulating reserves to fight an exchange rate appreciation of its currency. This was initially suggested in Aizenman and Riera-Crichton (2008), though Aizenman and Lee (2007) argue that on a quantitative dimension, the role of the mercantilist view is dwarfed by other determinants, particularly liquidity.

These different motivations for holding external debt, in turn, have led to alternative measures of the benefits of holding reserves. Rodrik and Velasco (1999) and Rodrik (2006) provide an assessment of the benefits of reserves in terms of avoiding financial crisis. They estimate a 10% reduction in the probability of a crisis, which combined with a 10% drop in output in such event entails a benefit equivalent to 1% of GDP that Rodrik suggests bodes reasonably with the spread differentials that countries pay to hold reserves. Levy Yeyati (2008) argues that, because of the positive effect of reserves on spreads, the costs of reserves has been overestimated.

In this literature, two issues have captured less attention than they deserve. First, the fact that it is typically assumed that the Central Bank and Government balance sheet is one and the same, even when short term debt is government's debt and not Central Bank debt. The issue of who accumulates reserves may be a relevant issue particularly if the Central Bank is independent, but has been largely ignored.

A second issue, that will be the main point discussed here, relates to the way the reserves

buildup is financed. In fact there are three main ways to purchase reserves: by unsterilized purchases, by issuing foreign currency denominated debt and by issuing domestic currency denominated debt. Does it matter which financing mechanism is used?

It is easy to see that the way reserves are financed has a bearing on the effect of reserves in many dimensions. First, and most obviously, accumulating reserves with foreign currency denominated liabilities provides liquidity but no hedge, understood as a way of improving the balance sheet of the Central Bank in times of distress. This differs from the effects of accumulating reserves with domestic currency denominated debt which provides both liquidity and hedge. At the same time, domestic currency liabilities may generate an incentive to inflate away the value of this debt, as shown in Calvo (1988). If interest rates increase in a capital outflow episode, this may trigger unstable expectations dynamics and require higher interest rate on domestic debt, thus weakening the hedging properties of domestic currency denominated debt. The maturity of the debt also matters, as the interest rate cost may become a source of unstable dynamics if maturities are shorter.

Accumulating reserves with liabilities entails an interest rate cost, known as carry. If issued in foreign currency this cost adds up the country risk and the time premia, as typically debt issued to finance reserves have a longer maturity than the assets where those resources are parked. This interest rate premia, can be thought as the "insurance" premia that pays off in terms of benefits of consumption smoothing when reserves are used, a benefit that, as was mentioned, Jeanne and Ranciere show justifies levels of reserves close to the values observed in most countries. When, accumulating reserves with domestic debt, the same calculation holds, except that the interest rate differential is typically larger because the local currency debt needs to compensate ex-ante for the devaluation of the domestic currency. Regardless of whether eventually the rate of devaluation compensates or not for this differential, it generates a communication issue for the Central Bank. A large interest differential exposes the Central Bank to criticism, thus

making the strategy more vulnerable.

Given the practical relevance of these effects it is somewhat surprising that there is relatively little literature, on evaluating the implications of how reserve accumulation is done. Levy Yeyati and Gomez (2019) somewhat address the issue, but only to assess the benefits of leaning against the wind policies. They show that central banks accumulating reserves financed with domestic currency may experience valuations gains if they follow a policy of purchasing to avoid large appreciations while selling at moments of distress. But they don't take the following step to see if this, which reinforces the hedging properties of reserves, leads to lower spreads.

In short, is the impact of reserves accumulation done through unsterilized purchases different from those done by accumulating local currency or foreign currency denominated liabilities? This is the issue explored in this paper. As we will see the results indicate that the source of financing matters. Accumulating reserves with domestic currency is beneficial in mitigating country risk (and more so the bigger the macro-vulnerability of the country), whereas accumulating reserves with foreign liabilities provide no visible benefit.

A Personal Motivation

The previous debate, has practical implications for central banking as I myself verified between 2015 and 2018 when I served as Governor of the Central Bank of Argentina. Upon taking office net reserves were negative, exchange rate controls were strict, and the black market premia was above 70% (an official rate traded at 9 pesos per dollar while the black market rate stood at around 16). As the result of the capital controls the economy had stagnated in the previous four years. Thus one of my initial decisions was to free capital controls, unify the exchange rate markets, and let the exchange rate float. This initial transition was successful with the exchange rate settling immediately at around 13 pesos per dollar, basically the mid point between the two previous exchange rates.The peso floated for the following two years with minimal Central

Bank intervention.

From this starting point, and considering that reserves were nonexistent, I decided to push for an aggressive program of reserves buildup. In the following two years the Central Bank of Argentina purchased about 40 billion dollars, about 8% of GDP. Purchases were done mostly to the government which at the time was financing a budget deficit with external debt. The fact that these purchases happened when the government issued debt, ie. with a timing that was independent of the value of the exchange rate, resulted in these purchases not affecting the liquidity or workings of an otherwise floating exchange rate market.

However, purchasing 8% of GDP in reserves was not cost free, in fact, the purchases were sterilized with short term Central Bank paper denominated in domestic currency. Thus, in the ensuing two years, as reserves piled up so did the amount of Central Bank liabilities. Figure 1 shows the evolution of these liabilities, of net reserves, and the evolution of central bank liabilities net of the growth in foreign reserves.

As can be seen, the process entailed a concomitant increase in net reserves and central bank liabilities with "unbacked" liabilities remaining roughly constant. The process of reserve accumulation peaked by the end of 2017, when net reserves had increased from negative to close to 40bn, while Central Bank liabilities had grown from around 25bn to around 75bn dollars. In spite of the equivalent increase in assets and liabilities, this process led to significant criticism: why were liabilities growing so fast? What was the cost of carry of these reserves?

In early 2018 Argentina was hit by a sudden stop[1]. The Central Bank reacted by selling reserves against short term liabilities. While the exchange rate depreciated, the Central Bank

[1]The sudden stop was the result of a series of macroeconomic mishaps. The government elected in late 2015 had maintained a large budget deficit that the market happily financed until midterm elections that the government won handsomely as output was growing and inflation coming down. With the benefit of hindsight, it is easy to see that the markets considered the electoral win as a deadline for starting fiscal consolidation while the government considered the win as an endorsement of its gradualistic approach to fiscal correction. As a result the government pushed a tax reform that decreased taxes and increased the inflation target to push the Central Bank into a less tighter mode. Both changes triggered market skepticism which shortly after became a sudden stop. See Sturzenegger (Forthcoming) for a description of the events.

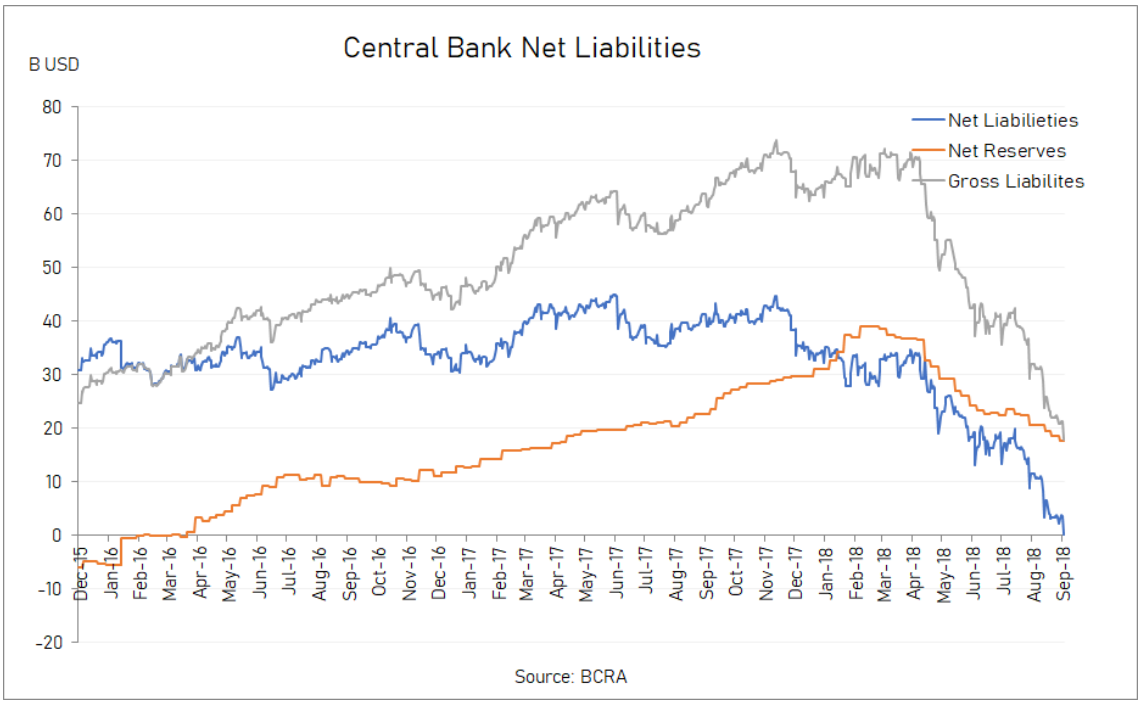

Figure 1: Central Bank Net Liabilities

also increased interest rates to contain the exchange rate depreciation. The increase in the interest rate, raised, in turn, the cost of Central Bank liabilities, thus casting doubts on the sustainability of the central bank's effort. Calvo (1988) suggests that an increase in domestic rates could change the incentives of the government: if the cost of the liabilities become too high, it could find optimal to default on domestic currency denominated debt by engineering an inflation putsch. According to Calvo, this implies that raising interest rates may in some circumstances *increase* inflation expectations rather than subdue them.

In this specific historical case something like this appears to have happened. After my resignation in June 2018, as the sudden stop aggravated the Central Bank initially increased rates further, but then in August implemented a one shot jump in the exchange rate and prices wiping out most of the Central Bank liabilities while doubling the inflation rate. Figure 1 shows how, between May and September, Central Bank liabilities decreased from 70 billion in late

April to about 18 billion in late September, a fall of 52 billion! In the same period net reserves fell from around 30 billion to the same 18 billion, a fall of 12 billion. Thus the large increase in inflation swept away all unbacked liabilities, that plunged from 32 billion to zero.[2]

This historical case poses some of the questions discussed in the previous section regarding whether accumulating reserves with domestic liabilities can have more or less costs than benefits relative to other forms of financing; and while here reserves delivered not only liquidity but also a sizable hedge; it is an open question if the possibility of kicking off unstable expectations dynamics at times of stress may have made them a suboptimal accumulation mechanism. This is the question that the next section wants to unveil by looking at cross country data.

2 The Data

As is standard in the literature, one way to estimate the effect of reserves is to evaluate if their accumulation affects government bond debt spreads. This is the road taken by Levy Yeyati and Gomez (2019). In this paper, we will focus on the issue of how the change in reserves is financed.

The IMF has worked to produce standardized data for Central Banks. The IMF starts from the balance sheet of the Central Bank and has managed to fit in this format data from around 145 countries with data running up to 2018.

[2]Of course, this implicit default was paid later on with exorbitant rates in the following two years which plunged the economy into a sharp recession.

Balance Sheet	
Claims on non-residents (1)	Liabilities to non-residents (a)
Claims on others depository corporations (2)	Monetary base (b)
Net Claims on Central Government (3)	Other Liabilities To Other Depository Corporations (c)
	Deposits and Securities other than Shares Excluded from Monetary Base (d)
	Loans (e)
	Financial Derivatives (f)
	Shares and equity (g)
	Other items (h)

From this balance sheet we construct the following variables, that slice it in ways that will allow us to estimate the separate effects of accumulating reserves from its three financing sources: foreign liabilities, monetary base and domestic currency liabilities.

Reserve Ratio = $(1)/GDP$

Remunerated Domestic Liabilities = $[(c)+(d)+(e)+(f)]/GDP$

Real Demand of Money = $[(b)+(g)+(h)-(2)-(3)]/GDP$

External Liabilities = $(a)/GDP$

The first variable, *Reserve Ratio*, is just the total claims on non residents (largely made up of gross reserves, which is the number typically used in the literature). *Remunerated Domestic Liabilities* is the amount of liabilities issued in domestic currency. *Real Demand of Money* defines the Monetary Base net of Domestic Credit, captures the amount of reserves that can be financed by the growth of monetary demand, net of the portion that is taken by the growth of domestic credit. Finally, *External Liabilities* represents liabilities incurred with non-residents. Of course these variables can also move by themselves without affecting reserves. For example, the Central Bank can issue domestic liabilities or even foreign liabilities to sterilize money demand. So our identification strategy will be to assess the impact of reserves on spreads by

holding constant two out of three of these possible sources of reserves changes. In this way we can isolate the impact of a change in reserves, arising from each of these three sources.

As control variables we use standard specifications from the literature. This includes, the degree of risk aversion in the market, defined as the spreads between an Option-Adjusted Spreads (OAS) index of all bonds in a given rating category and the Treasury curve (ICE BofAML Option-Adjusted Spreads constructed by Merrill Lynch); the rating of the country's debt[3], defined as the credit rating, constructed by S&P, of the long-term debt in foreign currency of each country; the world interest rate, defined as the US Treasury 10 year constant maturity yield (in basic points); and a measure of the stock of private and public debt (taken from World Bank). Data has monthly frequency. GDP data is smoothed to monthly frequency using splines. In some specifications we use year and country fixed effects. Appendix 1 lists the countries considered and Appendix 2 the variables and sources.

3 Estimating the Effect on Spreads

Table 1 shows the main results of the paper for the log-spread. Columns (1-2) extend the results in Levy Yeyati and Gomez (2019), with and without country fixed effects, to a larger number of countries. All the coefficients have the expected sign and are strongly statistically significant (the sole exception being the world interest rate in the specification with country fixed effects). Most relevant to the discussion here is the negative coefficient of reserves on spreads. An increase in 1% in the reserve to GDP ratio appears to reduce the country spreads by between 2.6 and 2.8%.

Columns (3-5) then splits the effect of reserves depending on how the reserves are accumulated. Column (3) for example adds as controls the amount of domestic liabilities and the real demand for money terms, thus by controlling for these two variables, we can reinterpret the

[3]We thank Juan Francisco Gomez for his assistance in the construction of this variable.

reserve coefficient as that obtained from moving reserves by accumulating foreign liabilities. The fact that the coefficient is not significant would indicate that there is no impact on spreads from accumulating reserves through this channel. Column (4) fixes money demand and foreign liabilities, so the reserve coefficient identifies the effects of reserve purchases using domestic debt. The coefficient here not only becomes significant but also larger than in the original specification, now a 1% increase in the reserves to GDP ratio accumulated through this channel reduces spreads by 3.6%. Column (5) shows the effect of accumulating reserves through unsterilized purchases, the effect is again significant but with a point estimate that is lower than that corresponding to the accumulation or reserves through issuing domestic currency debt. In this case a 1% increase in reserves reduces spreads by 2.6%. These results remain basically unchanged when introducing year fixed effects.

Table 1: Regresion results. Full Sample

	Dependent variable:							
	log(spread)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Risk Aversion	0.76***	0.78***	0.77***	0.78***	0.78***	0.96***	0.97***	0.97***
	(0.02)	(0.06)	(0.06)	(0.06)	(0.05)	(0.04)	(0.04)	(0.04)
Rating	−0.36***	−0.35***	−0.33***	−0.32***	−0.32***	−0.33***	−0.31***	−0.31***
	(0.03)	(0.11)	(0.11)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
World Rate	−0.29***	−0.17	−0.19*	−0.17	−0.18	0.20***	0.20***	0.20***
	(0.02)	(0.11)	(0.11)	(0.11)	(0.11)	(0.04)	(0.04)	(0.04)
Reserve Ratio	−2.58***	−2.76***	−0.74	−3.71***	−2.60***	−0.32	−3.37***	−2.28***
	(0.11)	(0.55)	(0.95)	(0.29)	(0.63)	(1.03)	(0.47)	(0.72)
Sovereign Debt	1.53***	1.56***	1.29**	1.13**	1.13**	1.00	0.84	0.84
	(0.05)	(0.53)	(0.56)	(0.54)	(0.53)	(0.68)	(0.66)	(0.66)
Private Debt	0.74***	1.01***	1.03***	0.92***	0.97***	0.93**	0.83**	0.86**
	(0.05)	(0.31)	(0.33)	(0.34)	(0.30)	(0.37)	(0.37)	(0.35)
Remunerated Domestic Liabilites			−3.21**		−1.23*	−3.35**		−1.29*
			(1.28)		(0.69)	(1.46)		(0.73)
Real Demand of Money			−2.00*	1.22		−2.10*	1.17*	
			(1.07)	(0.76)		(1.11)	(0.71)	
External Liabilities				4.58***	3.37***		4.55***	3.38***
				(1.24)	(0.86)		(1.27)	(0.92)
Constant	2.29***							
	(0.15)							
Fixed effects?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies?	No	No	No	No	No	Yes	Yes	Yes
Observations	4,497	4,497	4,497	4,497	4,497	4,497	4,497	4,497
Adjusted R^2	0.52	0.57	0.58	0.59	0.59	0.62	0.62	0.62

Note: *p<0.1; **p<0.05; ***p<0.01

Robust t-statistics in parentheses. Risk Aversion, Rating and World rate are expressed in logs, the remaining variables are ratios of GDP.

Table 2 shows the p-values[4] of the test of differences in the coefficients. The results show that the effect of accumulating reserves with foreign liabilities is statistically different to those resulting from accumulating with domestic denominated liabilities. In turn, the null hypothesis that the coefficient of the later two being equal cannot be rejected at standard values.

Table 2: Difference Test Between Coefficientes

	Reserve Ratio (3)	Reserve Ratio (4)	Difference	P-Value
Coefficient	-0.744	-3.71	2.966	0.00283***
Robust SE	(0.948)	(0.294)		

	Reserve Ratio (4)	Reserve Ratio (5)	Difference	P-Value
Coefficient	-3.71	-2.6	-1.1	0.112
Robust SE	(0.294)	(0.635)		

	Reserve Ratio (6)	Reserve Ratio (7)	Difference	P-Value
Coefficient	-0.315	-3.37	3.055	0.00685***
Robust SE	(1.03)	(0.468)		

	Reserve Ratio (7)	Reserve Ratio (8)	Difference	P-Value
Coefficient	-3.37	-2.27	-1.1	0.205
Robust SE	(0.468)	(0.724)		

Finally, Table 3 splits the sample into high and low devaluation rate countries. Countries with high devaluation rates are those which on average depreciated their currencies by more than 5% per year on average. This group comprises 60% of the sample. The results show that the results arise basically from the high devaluation rate countries. In short, the value of reserve accumulation, at least when measured in terms of impact on spreads, is not as relevant in economies with low inflation and stable macroeconomic frameworks. Similar results are

[4]Where the formula for the z-test is given by $Z = \frac{\beta_1 - \beta_2}{\sqrt{SE(\beta_1)^2 + SE(\beta_2)^2}}$

obtained when splitting the sample between high interest rates and high inflation rates, but we do not show the results here for brevity of exposition.[5] Those results suggests that while the value of reserves itself is relevant for countries with unstable macroeconomic frameworks, countries with low inflation appear not to benefit from a higher or lower level of reserves.

Table 3: Regresion results. High and Low Devaluation Rate Countries

	Dependent variable:					
	log(spread)					
	High Rate			Low Rate		
	(1)	(2)	(3)	(4)	(5)	(6)
Risk Aversion	0.97***	0.99***	0.98***	0.92***	0.92***	0.92***
	(0.04)	(0.04)	(0.04)	(0.07)	(0.06)	(0.06)
Rating	−0.35**	−0.34**	−0.33**	−0.17	−0.17	−0.17
	(0.14)	(0.13)	(0.13)	(0.12)	(0.12)	(0.12)
World Rate	0.17***	0.17***	0.17***	0.22***	0.22***	0.22***
	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)
Reserve Ratio	−0.26	−3.75***	−2.70***	−1.79	−1.41	−0.16
	(1.08)	(0.99)	(0.67)	(2.91)	(0.96)	(1.44)
Sovereign Debt	1.06	0.71	0.75	1.89*	1.91*	1.90*
	(0.75)	(0.76)	(0.76)	(0.99)	(0.99)	(1.00)
Private Debt	0.61	0.57	0.56	0.65	0.67	0.68
	(0.51)	(0.52)	(0.51)	(0.42)	(0.48)	(0.44)
Remunerated	−4.31**		−1.62*	0.35		−1.29
Domestic Liabilites	(1.75)		(0.92)	(3.38)		(1.48)
Real Demand	−2.77**	1.08		1.63	1.24	
of Money	(1.23)	(0.97)		(2.44)	(1.47)	
External Liabilities		5.14***	4.08***		−0.70	−1.88
		(1.42)	(0.87)		(3.64)	(2.84)
Fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,683	2,683	2,683	1,814	1,814	1,814
Adjusted R^2	0.67	0.67	0.67	0.64	0.64	0.64

Note: *p<0.1; **p<0.05; ***p<0.01

Robust t-statistics in parentheses. Risk Aversion, Rating and World rate are expressed in logs, the remaining variables are ratios of GDP.

[5]This results can be consulted upon request, -and in this version in an appendix not for publication at the end of the paper.

Table 4 dwells a bit further into this hypothesis, but looking at countries that have large fiscal deficits compared to those that have low deficits, and by looking at countries that have higher degrees of dollarization. The results are similar with some caveats.

When considering the group of countries that exhibit on average primary deficits[6], all forms of accumulating reserves reduce country spreads. Thus, for these countries the value of reserves seems to be paramount. Again accumulating reserves through the issue of domestic liabilities seems the most effective, in fact for these group of countries the coefficient indicates a 7% reduction in spreads for each additional point the reserves to GDP ratio increases through this mechanism. For countries with solid fiscal accounts, only the coefficient on the domestic liabilities financing coefficient remains significant.[7]

Regarding the relationship between reserves and dollarization, the previous results hold. We split the sample between countries with average deposits in dollars above 20% or more of total deposits ("dollarized countries") and the rest. Data is taken from (Levy Yeyati, 2006). Again countries with substantial dollarization do not benefit from accumulating reserves with foreign liabilities, whereas countries with low levels of dollarization show a mild improvement, hinting that the weaker effect of accumulating reserves with foreign liabilities may come from dollarized economies.

[6]We use "Primary net lending/borrowing (also referred as primary balance) (% of GDP) (GGXONLB_G01_GDP_PT)" from IMF. Annual primary deficits are calculated to maximize sample size.

[7]Both for this and the following exercise, we verified that the coefficients for these subsamples are similar to those of the original sample. The results are available upon request and are omitted for brevity -in this version presented in an appendix not for publication at the end fo the paper.

Table 4: Dollarization and Reserves

	Dependent variable:											
	log(spread)											
	With deficit			without deficit			dollarizated countries			Non-dollarizated countries		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Risk Aversion	1.00***	1.02***	1.01***	0.88***	0.88***	0.88***	0.93***	0.93***	0.93***	0.95***	0.97***	0.97***
	(0.04)	(0.03)	(0.04)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)
Rating	−1.40***	−1.31***	−1.36***	−2.09***	−2.03***	−2.04***	−1.49***	−1.48***	−1.49***	−0.94***	−0.87***	−0.91***
	(0.22)	(0.28)	(0.24)	(0.51)	(0.48)	(0.47)	(0.55)	(0.56)	(0.56)	(0.18)	(0.16)	(0.16)
World Rate	0.13*	0.14**	0.14**	0.20***	0.20***	0.20***	0.08	0.08	0.08	0.28***	0.28***	0.28***
	(0.07)	(0.07)	(0.07)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)
Reserve Ratio	−2.22***	−7.38***	−4.62***	−0.51	−2.09**	−1.46	−0.60	−4.48***	−2.91**	−2.35*	−3.13***	−1.50*
	(0.60)	(0.86)	(0.53)	(1.79)	(0.81)	(0.91)	(0.95)	(1.06)	(1.16)	(1.24)	(0.53)	(0.83)
Sovereign Debt	1.45***	0.89*	1.20***	2.46**	2.41**	2.40**	1.12*	0.93	1.00	1.20	1.28	1.13
	(0.44)	(0.51)	(0.45)	(1.06)	(1.21)	(1.19)	(0.68)	(0.69)	(0.70)	(0.99)	(0.91)	(0.93)
Private Debt	0.71**	0.79**	0.74**	−0.73*	−0.85**	−0.81**	0.68*	0.67*	0.66*	1.44	1.29	1.50
	(0.32)	(0.31)	(0.35)	(0.43)	(0.36)	(0.38)	(0.35)	(0.35)	(0.35)	(1.47)	(1.29)	(1.40)
Remunerated Domestic Liabilites	−6.11***		−3.64***	−1.64		−0.61	−3.97***		−1.73	−0.72		−1.70**
	(2.04)		(1.39)	(2.00)		(0.62)	(1.02)		(1.08)	(1.29)		(0.80)
Real Demand of Money	−2.38***	2.79***		−1.13	0.73		−2.25***	1.47		1.12	2.11***	
	(0.86)	(0.87)		(1.94)	(0.56)		(0.78)	(0.92)		(1.49)	(0.80)	
External Liabilities		6.10***	2.95***		2.63	1.93		4.30***	2.64***		6.73***	5.22*
		(1.21)	(0.71)		(3.19)	(3.04)		(0.97)	(0.91)		(2.45)	(2.71)
Observations	1,166	1,166	1,166	1,471	1,471	1,471	2,005	2,005	2,005	1,908	1,908	1,908
R^2	0.77	0.77	0.77	0.71	0.71	0.71	0.71	0.71	0.71	0.66	0.68	0.67
Adjusted R^2	0.77	0.77	0.77	0.71	0.71	0.71	0.71	0.71	0.71	0.65	0.67	0.66

Note: *p<0.1; **p<0.05; ***p<0.01

Robust t-statistics in parentheses. Risk Aversion, Rating and World rate are expressed in logs, the remaining variables are ratios of GDP. All regressions include year and fixed effects.

4 Discussion

This short paper addressed a simple but specific question: does it matter how a Central Bank accumulates reserves? For example, accumulating reserves with dollar debt, i.e. assets and liabilities with the same denomination, while providing liquidity in foreign currency, does not provide any hedge in distress situations. Local currency denominated debt, on the other hand, provides both hedge and liquidity. A possible concern with accumulating reserves with domestic currency interest paying liabilities, is that their cost may increase in a sudden stop thus thwarting their hedging power at moments of distress. Accumulating reserves by unsterilized interventions provides liquidity and hedge, and seems to be immune from the risks associated to the issue of domestic liabilities. On the other hand, unsterilized purchases may have a detrimental effects on other variables, such as inflation, which in turn may deteriorate country risk.

In this paper we looked at the evidence, to shed some light on the importance of these qualifications. The results for emerging economies appear to be quite strong. Using the country spread as an indicator of the effectiveness of reserve accumulation, the results suggest that accumulating reserves with foreign liabilities appears to achieve very little, whereas unsterilized intervention and purchases of reserves financed with domestic liabilities do seem to reduce country risk, with point estimates being stronger for the accumulation with domestic denominated liabilities. These results are compatible with the notion that under situations of distress, more important than liquidity is solvency, and that the fears of "a la Calvo (1988)" instability, while present at a theoretical level, do not seem to be relevant in practical terms, even for high inflation or interest rate countries.

References

Adler, G. and Tovar Mora, C. E. (2011). Foreign exchange intervention: a shield against appreciation winds? *IMF Working Papers*, pages 1–29.

Aizenman, J. and Lee, J. (2007). International reserves: precautionary versus mercantilist views, theory and evidence. *Open Economies Review*, 18(2):191–214.

Aizenman, J. and Riera-Crichton, D. (2008). Real exchange rate and international reserves in an era of growing financial and trade integration. *The Review of Economics and Statistics*, 90(4):812–815.

Bussière, M., Cheng, G., Chinn, M. D., and Lisack, N. (2015). For a few dollars more: Reserves and growth in times of crises. *Journal of International Money and Finance*, 52:127–145.

Caballero, R. J. and Panageas, S. (2003). Hedging sudden stops & precautionary recessions: a quantitative framework.

Calvo, G. A. (1988). Servicing the public debt: The role of expectations. *The American Economic Review*, pages 647–661.

Dellas, H. and Yoo, C. (1991). Reserve currency preferences of central banks. *Journal of International Money and Finance*, 10:406–419.

Dominguez, K. M., Hashimoto, Y., and Ito, T. (2012). International reserves and the global financial crisis. *Journal of International Economics*, 88(2):388–406.

Greenspan, A. (1999). Currency reserves and debt. In *Remarks before the World Bank Conference on Recent Trends in Reserves Management, Washington, DC*, volume 29.

IMF (2011). Assessing reserve adequacy. *IMF Policy Papers*.

Levy Yeyati, E. (2006). Financial dollarization: evaluating the consequences. *economic Policy*, 21(45):62–118.

Levy Yeyati, E. (2008). The cost of reserves. *Economics Letters*, 100(1):39–42.

Levy Yeyati, E. and Gomez, J. F. (2019). The Cost of Holding Foreign Exchange Reserves. CID Working Papers 353, Center for International Development at Harvard University.

Ranciere, R. and Jeanne, M. O. (2006). *The optimal level of international reserves for emerging market countries: formulas and applications*. Number 6-229. International Monetary Fund.

Rodrik, D. (2006). The social cost of foreign exchange reserves. *International Economic Journal*, 20(3):253–266.

Rodrik, D. and Velasco, A. (1999). Short-term capital flows. Technical report, National bureau of economic research.

Sturzenegger, F. (2019). Reserve management: A governor's eye view. *HSBC Reserve Management Trends 2019, Central Bank Publications*.

Sturzenegger, F. (2020). Macri´ s macro: The meandering road to stability and growth. *Brookings Papers on Economic Activity*, Forthcoming.

Torriani, M., P. O. and Vicens, M. (2020). Strategic asset allocation of a reserves porfolio: Hedging against shocks. *Central Bank of Argentina, Mimeo.*

A Annex

Table 5: Summary Statistics of Selected Variables

Statistic	N	Mean	St. Dev.	Min	Median	Max
Sovereign spread	4,497	409.83	334.41	21.20	321.77	3,863
Credit Rating	4,497	16.38	3.46	1	16	21
Reserves Ratio	4,497	0.15	0.08	0.0004	0.13	0.47
Sovereign Debt Ratio	4,497	0.23	0.15	0.01	0.19	0.83
Private Debt	4,497	0.13	0.16	0.00	0.08	0.96
Risk Aversion	4,497	573.48	286.38	257.14	488.91	2,030.95
10 Year US Treasury	4,497	3.11	1.02	1.50	2.89	5.39
Real Demand of Money Ratio	4,497	0.10	0.09	-0.14	0.09	0.41
External Liabilities Ratio	4,497	0.02	0.03	0.0	0.01	0.16
Remunerated Liabilities Ratio	4,497	0.04	0.05	0.0	0.02	0.23

Table 6: Variables and Sources

Name	Description	Source
Sovereign Spread	JP Morgan EMBI global index blended spread, in bps	The World Bank
Risk aversion	Merrill Lynch ICE BofAML Option-Adjusted Spreads	FRED
World Rate	US Treasury notes, 10 year constant maturity yield, bps	FRED
Credit rating	S&P rating, long term debt, end of period, foreign currency . We construct an index starting in 1 at Not Rated (NR) up to the top in 29 at "AAA".	Standard & Poor's
Sovereign Debt	Public and publicly guaranteed debt from private creditors	The World Bank's, International Debt Statistics (IDS)
Private Debt	External debt stock's, private nonguaranteed	The World Bank's ,International Debt Statistics (IDS)
GDP	GDP, current US dollars	The World Bank
Reserves Ratio	Claims on non residents	IFS
Remunerated Domestic Liabilities		IFS
Real Demand of Money		IFS
External Liabilities		IFS
Fiscal Balance	Primary net lending/borrowing	IMF (GGXONLB_G01_GDP_PT)
Dollarization	Deposits in dollars (as % of total deposits)	(Levy Yeyati, 2006)

B Not for publication tables

Table 7: Results for Fiscal Balance and Dollarization samples

	Dependent variable:					
	log(spread)					
	Dollar sample			Deficit sample		
	(1)	(2)	(3)	(4)	(5)	(6)
RiskA	0.94***	0.95***	0.95***	0.94***	0.95***	0.94***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
rating	−1.23***	−1.19***	−1.20***	−1.73***	−1.70***	−1.73***
	(0.24)	(0.26)	(0.26)	(0.50)	(0.54)	(0.55)
WRate	0.18***	0.19***	0.18***	0.17***	0.17***	0.17***
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
Reserve_ratio	−0.88	−3.12***	−2.12***	−0.96	−3.73***	−2.74***
	(0.70)	(0.43)	(0.55)	(0.78)	(0.98)	(0.88)
Sovereign.Debt	1.17**	1.06*	1.07*	1.12*	1.02	1.07
	(0.57)	(0.57)	(0.57)	(0.64)	(0.71)	(0.69)
Private_Debt	0.73**	0.68**	0.69**	0.85**	0.86**	0.82*
	(0.31)	(0.31)	(0.30)	(0.41)	(0.43)	(0.43)
Remunerated_Liabilities	−2.68***		−1.38**	−3.09***		−1.36
	(0.96)		(0.56)	(1.03)		(1.03)
Real_Demand_of_Money	−1.35**	1.03*		−1.93***	0.84	
	(0.68)	(0.55)		(0.70)	(0.88)	
External_Liabilities		3.09***	2.06**		2.86**	1.83
		(1.06)	(0.85)		(1.43)	(1.14)
Observations	3,913	3,913	3,913	2,637	2,637	2,637
R^2	0.66	0.67	0.67	0.67	0.67	0.67
Adjusted R^2	0.66	0.66	0.66	0.67	0.66	0.67

Note: *p<0.1; **p<0.05; ***p<0.01

Robust t-statistics in parentheses. Risk Aversion, Rating and World rate are expressed in logs, the remaining variables are ratios of GDP. All regressions include year and fixed effects.

Table 8: Regression by interest rate and inflation rate

	Dependent variable:											
	spread											
	High interest Rate			Low interest Rate			High Inflation Rate			Low inflation Rate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
RiskA	0.94***	0.94***	0.94***	0.96***	0.96***	0.96***	0.99***	0.99***	0.99***	0.95***	0.96***	0.96***
	(0.07)	(0.07)	(0.07)	(0.08)	(0.08)	(0.08)	(0.05)	(0.05)	(0.05)	(0.08)	(0.08)	(0.08)
rating	−1.12***	−1.09***	−1.10***	−0.63***	−0.53***	−0.56***	−1.28***	−1.27***	−1.30***	−0.24***	−0.23***	−0.23***
	(0.36)	(0.35)	(0.36)	(0.17)	(0.14)	(0.14)	(0.18)	(0.18)	(0.19)	(0.07)	(0.07)	(0.07)
WRate	0.31***	0.31***	0.31***	0.17**	0.18**	0.18**	0.22***	0.22***	0.22***	0.23***	0.23***	0.23***
	(0.05)	(0.05)	(0.05)	(0.07)	(0.07)	(0.07)	(0.04)	(0.05)	(0.05)	(0.07)	(0.07)	(0.07)
Reserve_ratio	−0.14	−2.35	0.47	1.03	−2.61**	−1.71**	−1.31	−1.81**	−0.54	1.36	−4.49***	−1.55
	(1.67)	(1.44)	(1.30)	(1.95)	(1.07)	(0.82)	(1.15)	(0.82)	(0.58)	(1.22)	(1.04)	(1.23)
Sovereign.Debt	1.02	0.75	0.80	1.37*	1.39*	1.38*	2.08***	2.14***	2.11***	1.32	1.21	1.24
	(1.07)	(1.20)	(1.19)	(0.74)	(0.73)	(0.74)	(0.67)	(0.77)	(0.74)	(0.84)	(0.80)	(0.80)
Private_Debt	−0.37	−0.34	−0.27	1.05*	1.04*	1.04*	1.12***	1.11***	1.13***	0.31	0.29	0.34
	(0.58)	(0.67)	(0.65)	(0.63)	(0.61)	(0.60)	(0.22)	(0.23)	(0.23)	(0.73)	(0.67)	(0.68)
Remunerated_Liabilities	−1.66		−2.45	−3.55		−0.89	−0.58		−1.29	−5.82***		−2.70
	(2.83)		(1.59)	(2.19)		(1.19)	(1.85)		(1.06)	(1.66)		(1.66)
Real_Demand_of_Money	0.78	2.98**		−2.70*	0.87		0.78	1.28		−2.83*	2.98*	
	(2.04)	(1.36)		(1.61)	(1.06)		(1.06)	(0.84)		(1.62)	(1.57)	
External_Liabilities		3.20	0.25		3.99**	3.09**		0.36	−0.88		6.49***	3.72**
		(3.21)	(2.70)		(1.85)	(1.29)		(1.89)	(1.27)		(1.56)	(1.67)
Observations	1,461	1,461	1,461	1,399	1,399	1,399	1,806	1,806	1,806	1,895	1,895	1,895
R^2	0.65	0.66	0.65	0.73	0.73	0.73	0.77	0.77	0.77	0.71	0.72	0.71
Adjusted R^2	0.65	0.65	0.64	0.72	0.72	0.72	0.76	0.76	0.76	0.70	0.71	0.71

Note: *p<0.1; **p<0.05; ***p<0.01