Exchange Rate Dynamics and the Central Bank's Balance Sheet*

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November 22, 2023

Abstract

Are nominal exchange rate variations linked to the central bank's balance sheet, in particular to remunerated domestic liabilities? We use two metrics of implied exchange rates based on central bank balance sheet data: one is a traditional metric that includes the monetary base, and the other adds remunerated domestic liabilities. We first estimate a VAR model to investigate the endogenous interactions between central bank balance sheet components for a set of seven Latin American countries for the 2006:01-2019:12 period. Then, we use a pairwise cointegration framework to compare these two metrics of implied exchange rate with the spot (observed) exchange rate. We find that the implied exchange rates and the spot exchange rate are cointegrated for most of the set of Latin American countries. We also find that for a subset of our sample, the spot exchange rate adjusts to the metric that adds remunerated domestic liabilities. We conclude that remunerated domestic liabilities matter for understanding exchange rate dynamics, and explore a simple theoretical setup to better understand the mechanism.

*We thank Jorge Ávila, Martin Uribe, two anonymous referees, participants at the 2021 Canadian Economics Association annual meeting and the University of Manitoba brown bag for their useful comments.

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1 Introduction

An increase in the domestic money supply, other things equal, is usually associated with a currency depreciation. However, some central banks issue debt at the same time, namely, remunerated domestic liabilities (RDL henceforth) that offset part of the increase of the monetary base. Using theory and data from eight Latin American countries we show that there is an interplay between RDL and spot (observed) exchange rates.

To introduce the data, consider a simplified balance sheet for a central bank with zero net worth:

Table 1: Simplified Balance Sheet of Central Bank

Assets	Liabilities
International Reserves	Monetary Base RDL

Table (2) shows components of the simplified balance sheet ranked by RDL as a fraction of GDP for eight Latin American countries in 2017.[1] The stock of RDL as a fraction of GDP averaged 10% across these countries, with considerable heterogeneity: the stock of RDL was around 20% of GDP for Uruguay and almost non-existent in Colombia.[2]

Table 2: Balance Sheet Components as a fraction of GDP, 2017 average

Country	Reserves	Mon. Base	RDL
Uruguay	0.24	0.05	0.20
Brazil	0.19	0.10	0.17
Peru	0.30	0.08	0.14
Argentina	0.08	0.08	0.12
Chile	0.14	0.06	0.11
Paraguay	0.20	0.11	0.06
Mexico	0.15	0.06	0.02
Colombia	0.15	0.09	0.00

Table (A9) provides a more global perspective by showing the balance sheet components for all countries in the IMF IMS data with RDL larger than 1% of GDP in 2017 (35 countries). RDL

[1] We analyze South American countries plus Mexico. Ecuador is excluded because it is dollarized, Bolivia because it has a fixed exchange rate, and Venezuela due to lack of data. Data for Argentina starts in 2017, so although we use as motivation and qualitative case study, we do not include this country in the econometric tests.

[2] See Appendix (A) for details on the construction of these variables and Appendix (B) for a discussion of the empirical relevance of additional balance sheet components (financial claims, domestic credit and external liabilities).

are prevalent in Latin American monetary policy with Uruguay, Brazil, Peru, Argentina and Chile being in the top 10 countries with respect to the stock of RDL as a fraction of GDP (Uruguay is second only to Malaysia). However, a scan of Table (A9) reveals the heterogeneity in our sample of Latin American countries parallels the range of countries in the IMF IMS database.

We investigate the extent to which RDL are a relevant fundamental for understanding exchange rate fluctuations. We conduct empirical exercises to compare the spot exchange rate with two implied exchange rate metrics that incorporate central bank balance sheet data. Both implied rates are the ratio of domestic liabilities (measured in domestic currency) to foreign assets (measured in US dollars). The first implied rate includes the monetary base while the second adds the RDL. These implied exchange rate metrics are sometimes used in economics and by financial market analysts (for instance, as described in Ávila, 2018), and they will depreciate (increase) when the liabilities increase and appreciate (decrease) when there is a higher accumulation of foreign assets.

In what follows we often abbreviate the implied rates as the "Conversion Exchange Rate" (CER henceforth) and define the "CER Base" as the metric that incorporates only the monetary base in the numerator.[3] In contrast, "CER Full" adds the RDL to the numerator of "CER Base". More formally, the metrics are:

$$\text{CER Base} \equiv \frac{\text{Monetary Base}}{\text{International Reserves}}, \tag{1}$$

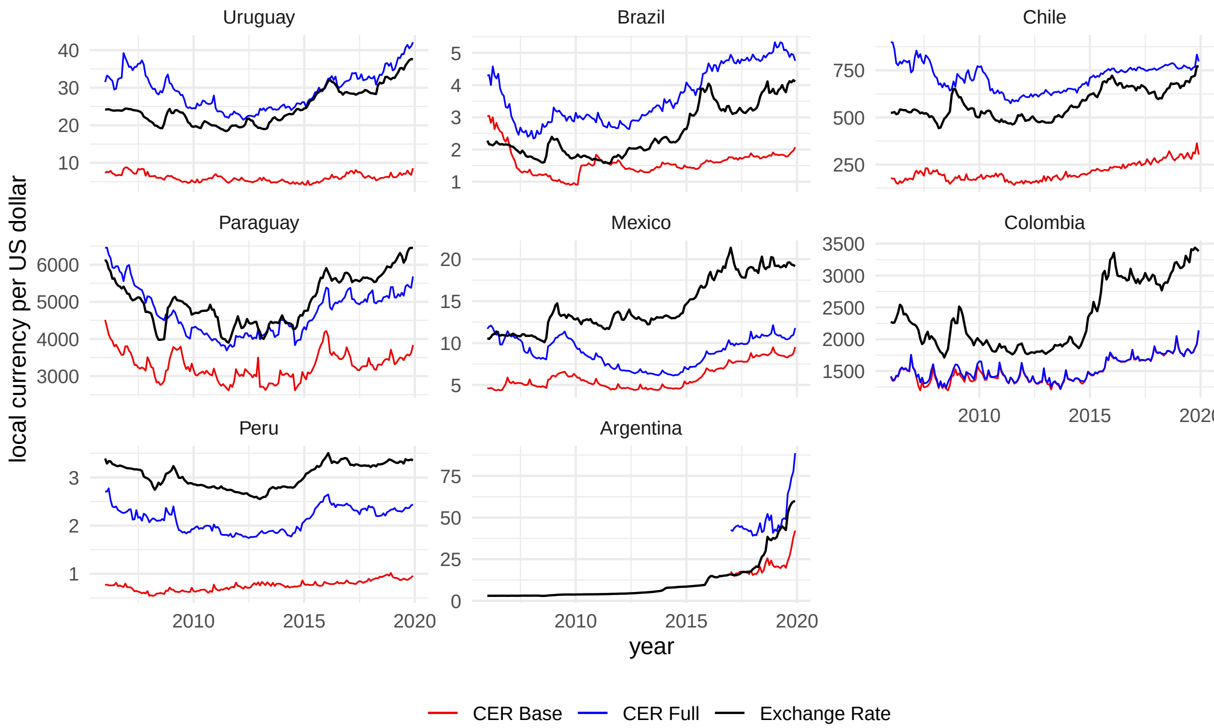
and

$$\text{CER Full} \equiv \frac{\text{Monetary Base+RDL}}{\text{International Reserves}}. \tag{2}$$

Figure (1) depicts the CER for the eight Latin American countries. Recalling that the difference between the CER Full and the CER Base is the addition of RDL to the numerator, it follows that the larger the RDL, the larger the difference between the two lines. The CER Full seems to track the spot exchange rate better than the CER Base, suggesting that RDL matters for understanding exchange rate dynamics. For Colombia and Mexico, however, the spot exchange rate and CER do not seem to be related. Recall from Table (2) that these two countries had little to no RDL. We formally test the link between these implied and spot rates using a pairwise cointegration framework.

[3] In spanish this is known as "Tipo de Cambio de Conversión" (Ávila, 2018).

Figure 1: Monthly Spot Exchange Rate and CER, 2006-2019



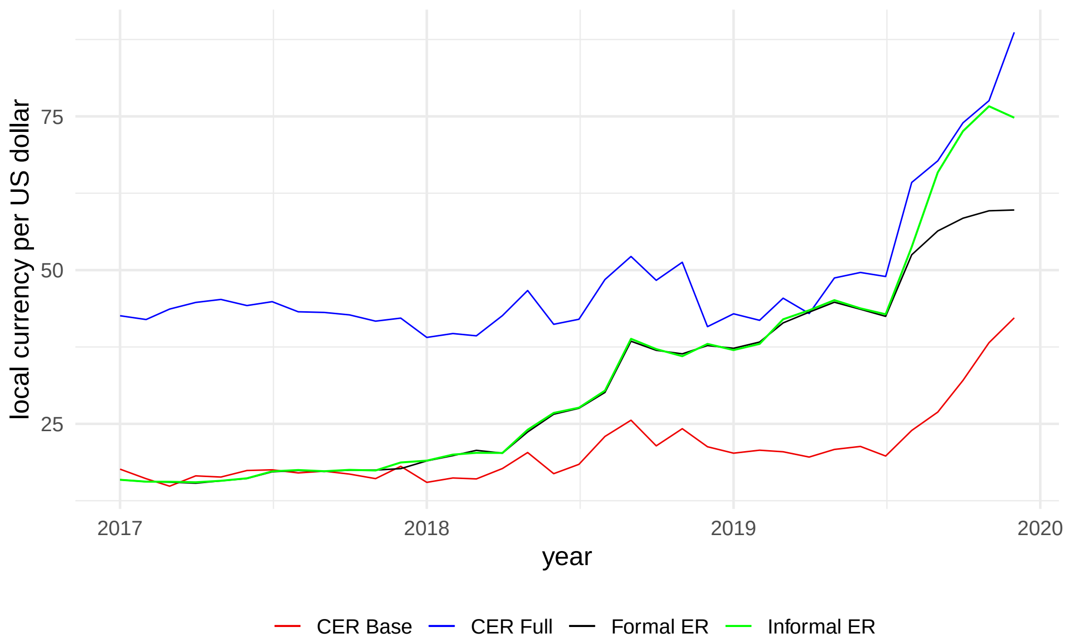
Source: Authors' calculations using IMF IFS data.

Motivation This paper is motivated by the large currency depreciation that Argentina experienced in 2018. This depreciation is depicted in Figure (2). Between April and September 2018, the Argentine peso lost half its value, depreciating from around 20 to 40 pesos per US dollar. The central bank had accumulated around 8% of GDP in RDL during the two years preceding the currency crisis. In Figure (2), we observe the time series for the 2017-2019 period (IMF IMS data for Argentina starts in 2017, hence we do not include it in the econometrics tests). Notice that we have included the "informal" exchange rate due to currency controls being imposed in late 2019. This creates a gap between the market exchange rate ("informal") and the official ("formal") one.[4] In 2018, there was a large devaluation, with the magnitude of this depreciation coinciding with the difference in the CER Base and CER Full. During the crisis, the spot exchange rate jumped from the former to the latter. This suggests the fundamental exchange rate value is indeed given by

[4]For the "informal" exchange rate, we use the 'Contado con Liquidación' exchange rate, a price implied from financial markets and available in the UCEMA-CEA database.

balance sheet measures that include RDL.[5] Through this lens before May 2018 the currency was overvalued relative to the fundamentals given by the central bank's balance sheet.

Figure 2: Argentina: Monthly Spot Exchange Rates and CER, January 2017-December 2019



Source: Authors' calculations using IMF IFS and UCEMA-CEA data.

With Figure (1) and Figure (2) in mind, we start by exploring potential endogenous relationships between the different components of the balance sheet (spot exchange rate, foreign reserves, monetary base, and RDL). Results from country-specific VAR estimations suggest that these components are indeed interconnected, and that the RDL has the potential to explain the dynamics of the rest of the balance sheet. However, at the same time, the apparent high degree of exogeneity or self-determinacy of the exchange rate creates challenges in attributing a significant share of its dynamics to other fundamentals.

To explore further, and to circumvent these issues related to the disconnect of the spot exchange rate from its fundamentals, we shift our focus to comparing pairs of spot-implied exchange rates directly using a pairwise cointegration framework to uncover potential long run relationship between the spot exchange rate and the two balance sheet implied counterparts (CER Base and

[5] For the period after the crisis (around May 2018), the CER Full is underestimated because the IMF bailout transfers were temporarily recorded as international reserves by the Central Bank (thus the actual reserves were lower, which implies a higher CER Full).

CER Full). By doing this, we are comparing prices (CER metrics vs spot exchange rates), hence the need for the pairwise cointegration framework.

Results from the pairwise cointegration analysis suggest that the RDL are a relevant determinant of the exchange rate in the long run for three of the countries in our sample that hold RDL: Brazil, Peru and Paraguay, the spot exchange rate moves to restore its long run equilibrium with the CER Full, suggesting that RDL matters. In Uruguay and Chile we do not find this pattern, which is relatively surprising and discussed more fully within the cointegration results. In Mexico and Colombia, we do not observe a long-run relationship either, although, given these countries have very few RDL, the results were expected.

Overall, our main contribution is in finding that RDL can matter for understanding exchange rate dynamics and should not be ignored.

Related Literature. Monetary theory tells us that the variation of the exchange rate is a function of the difference in supply and demand of money, relative to the foreign country, as exposed in for instance Obstfeld and Rogoff (1995). An increase in the money supply (or monetary liability), other things equal, leads to a currency depreciation. These theories, however, usually abstract from two features that are present in many emerging markets:

1. Many central banks follow intermediate exchange rate regimes (neither fixed or flexible exchange rate regimes): Frankel (2019) proposes to define an intermediate regime, called "systematic managed floating", as an arrangement where the central bank regularly responds to changes in total exchange market pressure by allowing some fraction to be reflected as a change in the exchange rate and the remaining fraction to be absorbed as a change in foreign exchange reserves.

2. Many central banks issue RDL, as reported before. Foreign exchange reserves are sometimes financed by issuing central bank debt: Sosa-Padilla and Sturzenegger (2023) study the link between central bank debt (RDL and external debt) and bond yields. We however focus on the link between RDL and the spot exchange rate.[6]

[6] Rodríguez (2018) studies the role of RDL on the risk of hyperinflation, while Rodríguez (1993) is an earlier contribution on the economic consequences of RDL with a focus on "quasi-fiscal" deficits.

Our intention is not in predicting exchange rates or linking exchange rates to determinants in the short run; a long-standing puzzle in international economics is the difficulty of tying floating exchange rates to macroeconomic fundamentals such as money supply, outputs, and interest rates (see Engel and West (2005) and references therein). Instead, our contribution is an investigation into the existence of a long run link between RDL and the spot exchange rate using central bank balance sheet data. We support our empirical result with a simple theoretical framework that shows how we expect the issuance of RDL to affect exchange rate dynamics.

The rest of the paper is organized as follows: in Section (2) we perform a VAR analysis to investigate endogenous interactions between central bank balance sheet components and in Section (3) we move to the pairwise cointegration analysis. A simple theoretical link between exchange rates and RDL is provided in Section (4) and we conclude in Section (5).

2 VAR Models for Balance Sheet Components

We estimate VAR models for each country with the variables represented in the balance sheet of the central bank — equations (1) to (2) — to investigate potential endogenous interactions between the balance sheet components involving the different definitions of CER (Base, Full). A separate VAR model is estimated for each of the seven countries with monthly data spanning 2006:01-2019:12.[7]. We transform the data by its logarithm and model it in levels or first differences depending on the presence of cointegration in each country, which is determined using the Johansen Multivariate cointegration by test Johansen (1991). In each case our estimation equation is:

$$\begin{aligned} X_t &= \Phi X_{t-1} + u_t, \\ u_t &\sim N(0, \Sigma_u), \end{aligned} \tag{3}$$

where $X_t = [rdl\ h\ mb\ er]'$, and rdl: remunerated domestic liabilities, h: foreign reserves, mb: monetary base, and er :exchange rate. The model in (3) denotes the companion VAR(1) representation of each VAR(p) model, i.e., we allow the model in each case to have a higher lag order which we

[7] As mentioned earlier, we do not include Argentina in the econometric test due to the IMF IMS time series starting in 2017 for this country

assign from a combination of the AIC criterion and subsequent adjustments to comply with the residuals assumptions (autocorrelation in the reduced form errors). The model chosen in each case is shown in table (A4).[8] Then, we perform causality tests based on Granger (1969) and a modified Wald test to consider whether the contemporaneous relationships show signs that the RDL cause the rest of the balance sheet.

Identification assumptions. A relevant discussion to note is about our implicit identification in these estimates. Although we are not particularly interested in identifying the structural shocks from these VARs or in carrying out impulse response analyses, we still must include a set of assumptions in these models to make the estimations feasible. To this end, a Cholesky-based exogeneity ordering is chosen as in the variable X_t above with the first variable experiencing no contemporaneous effects from the other reduced form shocks, and in that order, through to the last variable (er) which is affected contemporaneously by every shock. With this, we are allowing the exchange rate to be affected by every component of the balance sheet on impact, and we are also assuming that the debt variables (RDL) are a relatively discretionary tool that only reacts with a lag to the state of the rest of the economy.[9]

VAR Results. Results from multivariate cointegration are recorded in Table (3). The type of model estimated for each country is listed in the last column of Table (3). The importance of the RDL, based on the multivariate exercises that represent the structure of the balance sheet of the central banks is mixed. The causality test results shown in Table (A6) indicate that the RDL component causes the other variables for all economies in at least one way — Granger or instantaneously. The instantaneous causality test points to a stronger explanatory role by the RDL.

[8] Additional results related to VAR exercise are reported in Appendix (C).

[9] We tested alternative variable orderings for robustness, which led to similar conclusions. Included with the alternative variable orders is one with the domestic liabilities ordered first, and another with the exchange rate set first.

Table 3: Johansen Cointegration Test Results, by Country

Number of Cointegration Relationships from Johansen Test					
Country	Deterministic Component		Decision by Type of Test		
	Constant	Trend	Trace	Max. Eigenv.	Final Model (selected)
Uruguay	1 / 1	0 / 0	0 - Trend	0 - Trend	VAR(differences)
Brazil	3 / 1	1 / 1	1 - Const	1 - Trend	VEC/VAR(Levels)
Peru	1 / 1	1 / 1	1 - Const	1 - Const	VEC/VAR(levels)
Chile	3 / 2	1 / 1	1 - Trend	1 - Trend	VEC/VAR(levels)
Paraguay	4 / 1	0 / 0	0 - Trend	0 - Trend	VAR(differences)
Mexico	2 / 0	1 / 1	1 - Trend	0 - Const	VAR(differences)
Colombia	3 / 3	2 / 2	2 - Trend	2 - Trend	VEC/VAR(levels)

Notes: Each entry denotes the number of relations in the trace test / maximum eigenvalue test. The deterministic component refers to additional terms included in the cointegration relationship. The simplest model is selected (in number of relations and deterministic component(s)) for which the test is rejected.

To further investigate the importance of the liabilities component, we compute the forecast variance error decomposition (FEVD). We show the percentage of (forecast error) variance caused by each type of debt on the rest of the balance sheet components in Figure (3). In this case, the results suggest an explanatory role for the RDL.[10] We can say that, at least based on the VAR results, the RDL have more non-trivial potential for explaining the exchange rate and the rest of the balance sheet than the external liabilities. Now, an exception to this would be Colombia, for which the explained share is comparatively small.

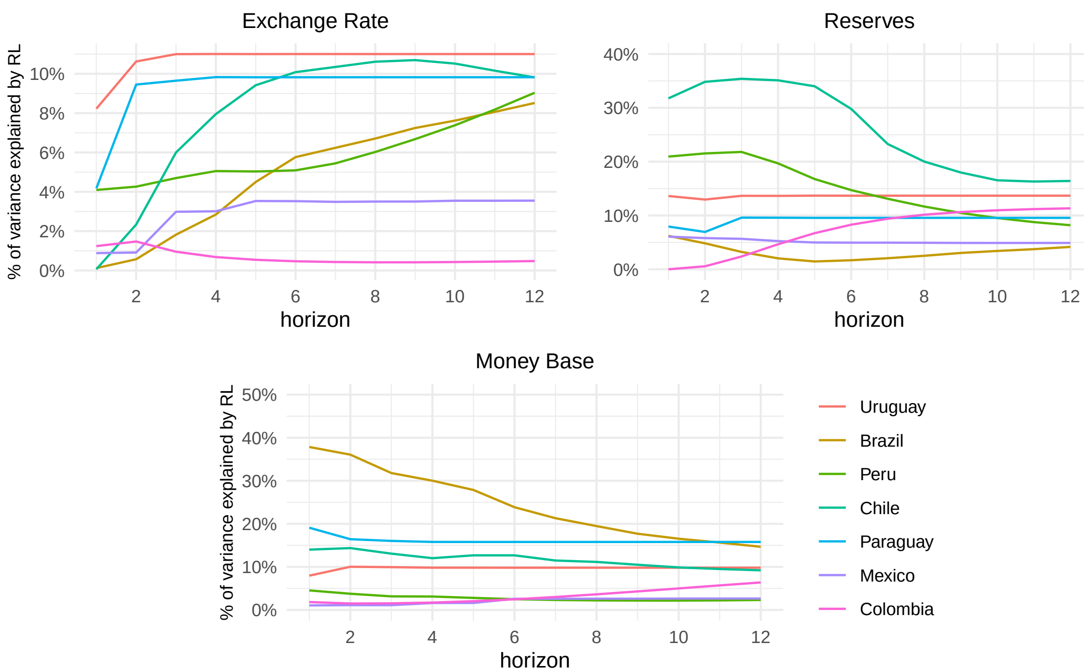
On the other hand, the multivariate approach results still hint that the exchange rate is a relatively self-determined variable, where comparatively, the self-explanatory percentage of variance is higher than on the other components of the balance sheet (except for the RDL themselves due to the identification that makes them relatively exogenous). This is shown in the Figure (A2). These features can be traced to the exchange rate disconnect puzzle (Obstfeld and Rogoff, 2001), upon which the fact the RDL can explain up to 14% of the exchange rate dynamics for some countries seems even more meaningful, but at the same time may render the multivariate framework limited to explain the —puzzling— dynamics of the exchange rate.

Thus, exploring the relevance of the debt components from a framework that circumvents

[10] Alternative VAR specifications with more debt components of the balance sheet also deliver a similar result, and in addition imply a substantially larger explained percentages of variance (see plots (A3) and (A4) in Appendix (C)) of the other components of the balance sheet by the RDL when compared, for example, with the share explained by the external liabilities.

the disconnect puzzle is more appropriate and in fact, is the reason the remainder of this paper is focused on an observed exchange rate-to-implied exchange rate comparison instead. The pairwise cointegration framework compares the relative alignment of conversion exchange rate measures, CER Base (no debt information) and CER Full (with remunerated domestic liabilities) against the spot exchange rate dynamics. If the latter metric is more aligned than the naive base measure that includes only the monetary base then we can attribute a relevant role to the way in which the reserves are financed — and the composition of debt the central bank uses — for understanding exchange rate movements.

Figure 3: FEVD for the Exchange Rate (upper left), Reserves (upper right), and Monetary Base (lower centre) (% explained by RDL)



3 Pairwise Cointegration Analysis

We test for threshold cointegration between 14 pairs of spot - implied exchanges rates. There are two pairs for each country: spot - CER Base and spot - CER full. The cointegration framework allows for non-linearity through thresholds. Threshold cointegration was first introduced by Enders and Siklos (2001), who extended the traditional cointegration test of Engle and Granger (1987) by allowing for a single threshold. They named their cointegration tests the threshold autoregressive

(TAR) and momentum TAR (M-TAR) test and applied them to the term structure of U.S. interest rates. Since then, threshold cointegration methods continue to evolve and have been used to investigate a broad range of topics including arbitrage in commodity markets (Subervie, 2011; Yahya et al., 2021; Galay, 2019), arbitrage in financial markets (Ters and Urban, 2020), purchasing power parity (Woo, Lee and Shum, 2021) and macroeconomic fundamentals (Wei, Qin, Li, Zhu and Wei, 2019).

For each pair, our test for threshold cointegration follows two steps. First, we transform data by its logarithm and investigate the order of integration of each series using the Augmented Dickey Fuller (ADF) unit root test (Dickey and Fuller, 1979, 1981). When the series are found to be integrated of the same order, we move to the second step and employ the threshold cointegration technique of Sephton and Mann (2013) which combines the threshold selection method of Gonzalo and Pitarakis (2002) with the F-test developed by Seo (2008). The test for threshold cointegration examines the residuals from the cointegrating regression in equation (4), and conditional on selecting one or more thresholds (for expository purposes, we assume there are three in equation (5), denoted by τ_1, τ_2 and τ_3) it examines the null hypothesis that all correction coefficients are zero ($\delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$) against the alternative they are not jointly zero. The Heaviside indicator portion of equation (5) is the only component that changes when less than three thresholds are found. In the case of zero thresholds the equation collapses on the testing equations of the traditional cointegration test of Engle and Granger (1987). Finally, residual based block bootstrapping is used to draw inference when one, two, or three thresholds are found and critical values by MacKinnon (1996) are used to draw inference when zero thresholds are found.

$$Y_t = \beta_1 + \beta_2 Trend_t + \beta_3 X_t + \varepsilon_t, \quad (4)$$

$$\triangle\varepsilon_t = \delta_1 \varepsilon_{t-1} \mathbb{1}_{\varepsilon_{t-1}<\tau_1} + \delta_2 \varepsilon_{t-1} \mathbb{1}_{\tau_1<\varepsilon_{t-1}<\tau_2} + \delta_3 \varepsilon_{t-1} \mathbb{1}_{\tau_2<\varepsilon_{t-1}<\tau_3} + \delta_4 \varepsilon_{t-1} \mathbb{1}_{\tau_3<\varepsilon_{t-1}} + \sum_{i=1}^{p} \alpha_i \triangle\varepsilon_{t-i} + v_t, \quad (5)$$

where

- Y_t and X_t are the logged implied exchange rate (*Base* or *Full*) and the exchange rate (*er*).
- ε_t is the residual from the cointegrating regression from equation (4).
- $\tau_1 < \tau_2 < \tau_3$ are the thresholds that divide observations into regimes.

- $\mathbb{1}_{\text{condition}}$ is a Heaviside indicator function taking the value of 1 if the subscript condition holds, and Δ is the difference operator.

The advantage of Sephton and Mann (2013) over the traditional approach is that it endogenously determines both the number of thresholds and their location. Most cointegration techniques either assume the absence of thresholds (e.g., traditional Engle and Granger test); that a single threshold exists and is equal to zero (hence separating observations into two regimes with ε_{t-1} being positive in the first and negative in the second); or that two thresholds exist that are symmetric around zero. Here, we allow for as few as zero thresholds and as many as three thresholds. If the procedure selects two thresholds, they may be symmetric about zero, but this decision is not determined a priori. The method collapses to the Engle and Granger test if the procedure selects zero thresholds. For further details on the threshold cointegration technique, including size and power properties, see Sephton and Mann (2013).

When we reject the null hypothesis that all correction coefficients are zero ($\delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$) against the alternative they are not jointly zero we move to a third step and estimate the error correction model (ECM) expressed in equation system (6-7). Again, the Heaviside indicator portion of the equation system is the only component that changes when less than three thresholds are found. Importantly for our purposes, the gamma terms from the ECM indicate which of the variables adjust to restore the system to its long run relationship. If one of the series does not adjust, it is considered weakly exogenous and termed the dominant series. The ECM highlights the importance of endogenously determining the number of thresholds. If we had assumed linear cointegration (i.e., zero thresholds), the ECM would suffer from omitted variable bias when the optimal number is one, two or three thresholds.

$$\begin{aligned}\triangle Y_t = {} & \gamma_1 \varepsilon_{t-1} \mathbb{1}_{\varepsilon_{t-1}<\tau_1} + \gamma_2 \varepsilon_{t-1} \mathbb{1}_{\tau_1<\varepsilon_{t-1}<\tau_2} + \gamma_3 \varepsilon_{t-1} \mathbb{1}_{\tau_2<\varepsilon_{t-1}<\tau_3} + \gamma_4 \varepsilon_{t-1} \mathbb{1}_{\tau_3<\varepsilon_{t-1}} \\ & + \sum_{i=1}^{p} (\alpha_i \triangle Y_{t-i} + \beta_i \triangle X_{t-i}) + u_t,\end{aligned} \tag{6}$$

$$\begin{aligned}\triangle X_t = {} & \gamma_5 \varepsilon_{t-1} \mathbb{1}_{\varepsilon_{t-1}<\tau_1} + \gamma_6 \varepsilon_{t-1} \mathbb{1}_{\tau_1<\varepsilon_{t-1}<\tau_2} + \gamma_7 \varepsilon_{t-1} \mathbb{1}_{\tau_1<\varepsilon_{t-1}<\tau_2} + \gamma_8 \varepsilon_{t-1} \mathbb{1}_{\tau_2<\varepsilon_{t-1}} \\ & + \sum_{i=1}^{p} (\chi_i \triangle Y_{t-i} + \delta_i \triangle X_{t-i}) + v_t,\end{aligned} \tag{7}$$

where

- Y_t and X_t are the logged implied exchange rate (*Base* or *Full*) and the exchange rate (*er*).
- ε_t is the residual from the cointegrating regression from equation (4).
- $\tau_1 < \tau_2 < \tau_3$ are the thresholds that divide observations into regimes.
- γ_i are the regime specific speeds of adjustment to the long run relationship.
- $\mathbb{1}_{\text{condition}}$ is a Heaviside indicator function and Δ is the difference operator.

Here we allow for as many as three thresholds, and as few as zero. In the absence of thresholds, the relationship between the variables is linear because there is only one gamma term. With only one gamma term, the speed of adjustment to the long run relationship is the same no matter the distance i.e., lagged residual, from the long run relationship. The relationship is nonlinear when gamma terms from the threshold ECM differ across regimes. This means the speed of adjustment to the long run relationship depends on the distance i.e., lagged residual, from the long run relationship. Since the number of thresholds and their location are endogenously determined, it follows that the cointegration technique allows for a nonlinear relationship but does not force non-linearity.

Pairwise Cointegration Results Results from the unit root tests are recorded in Table (A7) are consistent across all seven countries and provide evidence that each series is I(1). Results from the pairwise threshold cointegration tests and the coefficient significance for the cointegrated pairs are mixed and are summarized in Table (4) with a full table of results in (A8).

CER Base We find cointegration between the spot and CER Base exchange rate in six out of seven countries (given by the statistical significance of estimated parameter in column "Test Statistic"): Uruguay, Brazil, Peru, Chile, Paraguay, and Colombia. Only Mexico is not cointegrated. The estimated ECM parameters indicate that the implied exchange rate CER Base is adjusting to the spot rate in the long run (given by "YES" in at least one column of γ parameters). Only for Peru does the spot rate also adjust to the CER Base.

CER Full We find cointegration between the CER Full and the spot exchange rate for five out of seven countries. Now, Mexico and Chile are not cointegrated. The estimated parameters again indicate the implied exchange rate CER Full adjusts to the spot rate in the long run for each cointegrated country, but critically, now the spot rate also adjusts to the CER Full for the cases of Brazil, Peru and Paraguay. Exchange rates thus are affected by RDL in these countries.

Table 4: Pairwise Cointegration Results

			CER Adjusts				Spot Adjusts			
Case	Thresholds	Test Statistic	γ_1	γ_2	γ_3	γ_4	γ_5	γ_6	γ_7	γ_8
CER Base										
Uruguay	3	19.389*	YES	NO	YES	YES	NO	NO	NO	NO
Brazil	1	17.520***	NO	YES	-	-	NO	NO	-	-
Peru	3	24.780**	YES	YES	YES	YES	NO	YES	NO	NO
Chile	3	22.848**	YES	YES	YES	YES	NO	NO	NO	NO
Paraguay	2	54.443***	YES	YES	YES	-	NO	NO	NO	-
Mexico	3	12.521	-	-	-	-	-	-	-	-
Colombia	3	23.793**	YES	YES	NO	YES	NO	NO	NO	NO
CER Full										
Uruguay	2	17.9175**	NO	NO	YES	-	NO	NO	NO	-
Brazil	2	20.760**	YES	NO	YES	-	YES	NO	YES	-
Peru	3	31.388***	NO	YES	NO	NO	YES	NO	NO	YES
Chile	1	10.033	-	-	-	-	-	-	-	-
Paraguay	3	23.587**	NO	YES	NO	YES	YES	NO	NO	NO
Mexico	1	5.431	-	-	-	-	-	-	-	-
Colombia	3	25.785***	YES	YES	NO	YES	NO	NO	NO	NO

Notes: The null hypothesis is no cointegration against an alternative of (threshold) cointegration. Input specifications for the threshold cointegration tests: threshold locations include the middle 90% of observations divided into 50 increments; each regime requires a minimum of 24 observations (binds for 3 of 16 pairs); AIC used throughout; critical values for the threshold cointegration test simulated following the residual-based block bootstrap methodology by Seo (2008) with a block length of 6 and 999 replications under the null. Significance at α = 0.10, 0.05 and 0.01 denoted by *, **, and *** respectively.

3.1 Pairwise Cointegration Results Discussion

The fact that the implied measures adjust in the long run to the spot rate is not surprising as they both carry common information. What is more important, however, is whether the observed spot rates adjust to the implied rates —and to which ones. Given that in Brazil, Peru and Paraguay, the spot exchange rate adjusts to the CER metric that includes RDL, the exchange rates for these countries are affected by RDL.

Surprisingly, this result does not hold in Uruguay and Chile, countries that also have substantial RDL. The case of Uruguay (cointegrated but with an exchange rate not adjusting to CER Full) provide evidence that the relationship we are studying does not just hold mechanically but that the way the liabilities are accumulated may be relevant; that is, other factors can be affecting the link between RDL and exchange rates. Some examples include the size of other balance sheet components (as discussed in Appendix (B)), idiosyncratic characteristics of the monetary/financial market (such as differences in financial depth), debt instruments characteristics (such as degree of debt indexation), as well as other country specific features (sovereign bond yields, etc.).[11]

If we consider that, in contrast, the VAR indicates that RDL are relevant for Uruguay and Chile, then we would have indications that RDL matter, but only in the short run. On the other hand, the lack of a meaningful connection between the CER Full and the spot both in the short run (VAR) and long run (threshold cointegration) for Mexico and Colombia is not surprising. Both countries hold very few RDL, as indicated in Table (2).

Overall, these results indicate that an implied exchange rate metric that does not include RDL ignores relevant sources of exchange rate variations. Thus, RDL matter for understanding exchange rate dynamics.

4 Understanding the mechanism

What are the origins of equations (1) and (2)? How can we think of the relationships described previously? In this section we provide a simple theoretical link between exchange rates and RDL.

We follow the main building blocks and notation in Engel and West (2005) (see references therein for earlier contributions), however we extend the framework to allow for accumulation of international reserves and RDL.[12]

Assume that in the home country there is a money market relationship given by

$$m_t = p_t + \gamma y_t - \alpha i_t + v_{m,t}. \tag{8}$$

[11] To inquire further on this end, future research can try to tackle cross country differences of the impact of RDL in exchange rates.

[12] We use reduced form equations, but many of these equations can be derived from microfounded models, as in Obstfeld and Rogoff (1995) or Vegh (2013).

Here, m_t is the log of the home money supply, p_t is the log of the home price level, i_t is the level of the home interest rate, y_t is the log of output, and $v_{m,t}$ is a shock to money demand. We assume a similar equation holds in the foreign country, where the analogous foreign variables are m_t^*, p_t^*, i_t^*, y_t^* and $v_{m,t}^*$, and the parameters of the foreign money demand are identical to the home country's parameters.

The nominal exchange rate equals its purchasing power parity (PPP) value plus the real exchange rate:

$$s_t = p_t - p_t^* + q_t. \tag{9}$$

The (uncovered) interest parity relationship obtained from the financial markets is:

$$E_t s_{t+1} - s_t = i_t - i_t^* + \rho_t. \tag{10}$$

Here, ρ_t can be interpreted as a risk premium or an expectational error. Putting these equations together and rearranging, we get an expression for the spot rate along the lines of Engel and West (2005)

$$s_t = \frac{1}{1+\alpha}\left[m_t - m_t^* - \gamma\left(y_t - y_t^*\right) + q_t - \left(v_{m,t} - v_{m,t}^*\right) - \alpha\rho_t\right] + \frac{\alpha}{1+\alpha}E_t s_{t+1}. \tag{11}$$

To interpret this equation, assume $\gamma = 1$, $q_t = 0$, $v_{m,t} = v_{m,t}^*$, $\rho_t = 0$, and let $b \equiv \frac{1}{1+\alpha}$, thus

$$s_t = b\left[m_t - m_t^* - (y_t - y_t^*)\right] + (1-b)E_t s_{t+1}. \tag{12}$$

The observable fundamentals are given by $f_{1t} = m_t - m_t^* - (y_t - y_t^*)$. Thus exchange rates are a function of the relative difference between money supplies and output growth. Expected exchange rates also affect spot exchange rates.

We consider an environment where the central bank can respond to changes in total exchange market pressure by allowing some fraction of it to be reflected as a change in the exchange rate and some absorbed as a change in foreign exchange reserves (as in Frankel, 2019), but additionally, now the RDL can also absorb some of the pressure. In this context, a positive productivity shock, for instance, that leads to an increase in output y_t might be reflected as combination of an appreciation, reserve accumulation and a change in the stock of RDL. We thus need to introduce international reserves and RDL into the picture.

Central Bank's Balance Sheet A simplified Central Bank's balance sheet is given by

Assets	Liabilities
$s_t H_t$	MB_t
	RDL_t

H_t are international reserves (in foreign currency, "dollars"), s_t the exchange rate, MB the monetary base and RDL_t the remunerated domestic liabilities issued by the Central Bank (in domestic currency, "pesos").[13]

Here we have abstracted from other balance sheet components and are assuming zero net worth.[14] Then, it holds that $s_t H_t = MB_t + RDL_t$. Rearranging, we get the relationship used in our empirical exercises:

$$s_t = \frac{MB_t + RDL_t}{H_t} \tag{13}$$

Define total liabilities (TL_t) as the sum of monetary base and remunerated domestic liabilities, $TL_t = MB_t + RDL_t$ and let $\omega \equiv \frac{MB_t}{MB_t+RDL_t}$ be the weight of the monetary base in total liabilities (and thus $1-\omega_t = \frac{RL_t}{MB_t+RDL_t}$). Then, taking logs and differentiating with respect to time, the dynamics of the exchange rate is given by

$$\frac{\Delta s_{t+1}}{s_t} = \omega \frac{\Delta MB_{t+1}}{MB_t} + (1-\omega)\frac{\Delta RDL_{t+1}}{RDL_t} - \frac{\Delta H_{t+1}}{H_t} \tag{14}$$

where Δ represents changes. Equations (14) and (12) have some similarity: other things equal, the exchange rate depreciates with increases in the monetary liabilities (which now also includes RDL) and appreciates with output growth (with tends to increase international reserves).[15]

As a result, a framework that does not include remunerated liabilities ($\triangle RDL_{t+1} = 0$) may ignore relevant sources of exchange rate variations, if the central bank indeed accumulated such

[13]For a model with valuation of the assets held by the central bank, see Ghironi, Lee and Rebucci (2015).

[14]See the Appendix A for a complete balance sheet diagram where the components comprising RDL are reflected. Additionally, see the Appendix B for an empirical analysis that justifies why we focus on this particular simplication and not one with more components.

[15]International reserves grow with money demand, as in the monetary approach to the balance of payments (Johnson, 1977). Furthermore, holding constant the money multiplier, variations in the monetary base and money supply are equal.

type of debt. This is consistent with our findings: RDL matter to understand exchange rate dynamics.

In summary, the simplified theory laid out in this section is consistent with the empirical findings previously reported: exchange rates can relate to the stock of RDL when countries decide to make use of such policy instrument.

5 Conclusion

In this paper we investigate the extent to which RDL are a relevant fundamental for understanding exchange rate fluctuations. Based on a pairwise cointegration framework, we compare the spot exchange rate with two implied exchange rate measures and find that the spot and implied exchange rate that incorporates only the monetary base (CER Base) is cointegrated for six out of seven countries while the implied exchange rate that incorporates monetary base and RDL (CER Full) is cointegrated for five out of seven countries. For the cointegrated countries, the spot rate only adjusts to restore the long run equilibrium with CER Base for Peru, while, in contrast, it adjusts to restore the long run equilibrium with CER Full for Brazil, Peru, and Paraguay.

This suggests that RDL are a relevant fundamental for understanding exchange rate fluctuations. Consistently, a simplified balance sheet setup delivers a link between exchange rates and RDL and, together with the empirical results, show that a framework that does not include RDL risks ignoring relevant sources of exchange rate variation.

These results also suggest the existence of additional policy trade-offs involved when deciding on an exchange rate regime: deciding to use central bank debt or not. We are currently investigating (work in progress) the link between RDL and the 2018 currency crisis in Argentina, with a Mundellian Trilemma approach (Mundell, 1963; Fleming, 1962).

Additional future research can investigate several implications of this types of monetary policy: for instance, the link between RDL, credibility and optimal inflation targeting. Another relevant dimension is the importance of different type of indexing arrangements for these debt instruments; when debt in local currency is indexed, the currency fluctuation effect is dampened in real terms. This can alter incentives to use exchange rate movements for 'hedging' purposes. Furthermore, empirical extensions of our paper also look like a promising area of research.

We conclude with the main finding of our paper: remunerated domestic liabilities (RDL) matter for understanding exchange rate dynamics.

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A Data Sources

We use standardized central bank balance sheet data from the IMF-IFS statistics.[16] The table below, from Sosa-Padilla and Sturzenegger (2023), summarizes the relevant balance sheet data that we will use:

Table A1: Central Bank Balance Sheet

Assets	Liabilities
Claims on non-residents (1) Claims on others depository corporations (2) Net Claims on Central Government (3)	Liabilities to non-residents (a) Monetary base (b) 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)

Following Sosa-Padilla and Sturzenegger (2023), we define:

- Reserves = (1)
- Remunerated domestic liabilities = $(c)+(d)+(e)+(f)$
- Monetary Base = (b)
- External Liabilities = (a)
- Other Balance Sheet = $(g)+(h)-(2)-(3)$

The CER metrics -Equations (1) and (2)- we use in this paper are thus:

$$\text{CER Base} = \frac{(b)}{(1)}$$

$$\text{CER Full} = \frac{(b)+(c)+(d)+(e)+(f)}{(1)}$$

[16] The documentation can be accessed in Cartas and Harutyunyan (2017).

B Other Balance Sheet Components

In this appendix section we justify the simplified balance sheet approach used in this paper, as shown in Table (1). In particular, we show that “External Liabilities" (another source of central bank liabilities) are less relevant to understand exchange rate dynamics, compared to RDL. The balance sheet below represents a realistic T-account of a central bank. As observed, relative to Table (1), we now have “Net Financial Claims" and “Net Domestic Credit" on the asset side. On the liability side we have “External Liabilities".

Table A2: Summarized Balance Sheet of Central Bank

Assets	Liabilities
International Reserves	Monetary Base
Net Financial Claims	RDL
Net Domestic Credit	External Liabilities

In Table (A3) we show that these components for the countries in our sample:

Table A3: Balance Sheet Components as a fraction of GDP, 2017 average

Country	Reserves	Mon. Base	RDL	Ext. Liab.	Net Fin. Claims	Net Dom. Credit
Uruguay	0.24	0.05	0.20	0.02	-0.02	0.05
Brazil	0.19	0.10	0.17	0.01	-0.01	0.10
Peru	0.30	0.08	0.14	0.00	0.02	-0.10
Argentina	0.08	0.08	0.12	0.03	0.00	0.14
Chile	0.14	0.06	0.11	0.00	0.03	-0.00
Paraguay	0.20	0.11	0.06	0.01	0.02	-0.04
Mexico	0.15	0.06	0.02	0.00	0.01	-0.08
Colombia	0.15	0.09	0.00	0.00	-0.05	-0.01

On the liability side, External Liabilities tend to be much smaller than RDL—in 2017 it averaged 1% of GDP, while RDL averaged 10% of GDP. Thus, RDL is what mostly explains central bank debt, and hence, we think that abstracting from External Liabilities as we do in this paper is appropriate.

On the asset side (measured in net terms, thus can be negative): “Net Financial Claims" are small, however "Net Domestic Credit" can be larger in absolute terms. In this paper we abstract from Net Domestic Credit, a tool used mainly for open market operations. We focus on foreign exchange and RDL intervention here. We do recognize that this can be important, but our focus are on central bank liabilities.

Naturally, we could inquire on how would our measures change if we include all balance sheets component in our CER measure. Using all of these components, we can define a "complete" CER metric:

$$\text{CER Complete} \equiv \frac{\text{Mon. Base} + \text{RDL} - \text{Fin. Claims} - \text{Dom. Credit}}{\text{Reserves} - \text{Ext. Liab.}} \tag{15}$$

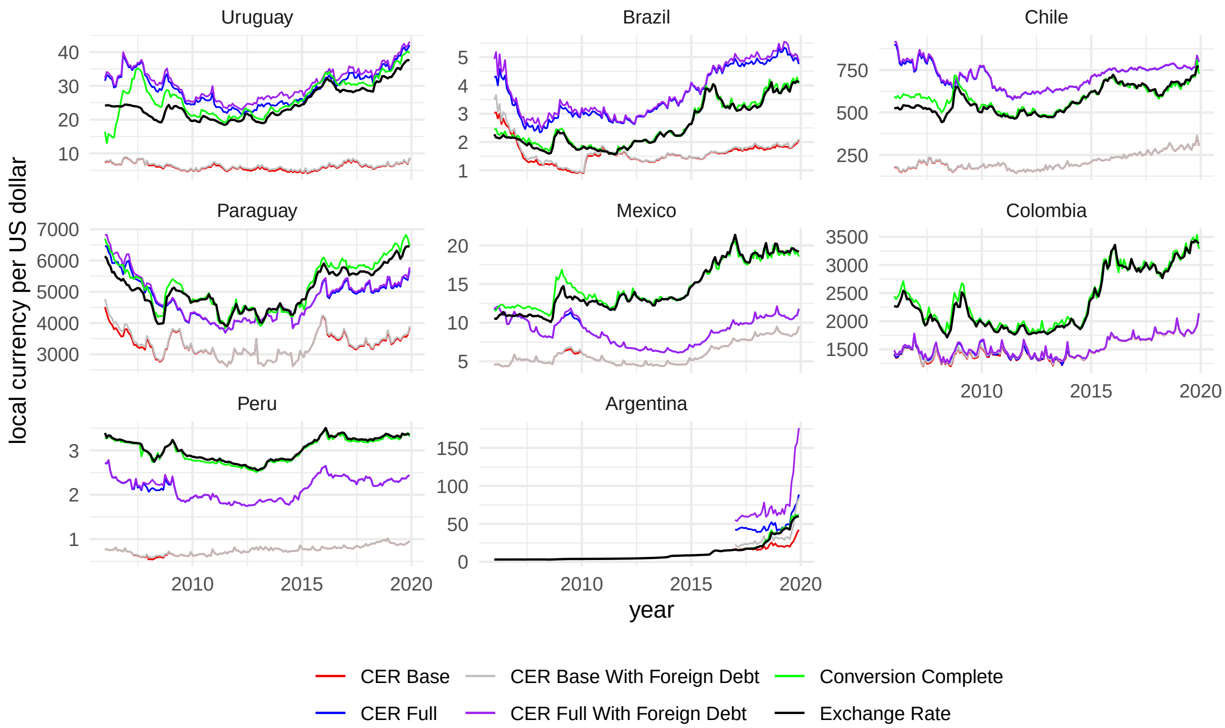
Or, in terms of the labels in Table (A1) used in the previous section:

$$\text{CER Complete} = \frac{(b) + (c) + (d) + (e) + (f) - (2) - (3) + (g) + (h)}{(1) - (a)}$$

Figure (A1) shows the time series for such metric (in light green). As observed, this Complete CER tracks the exchange rate almost 1 to 1 (measurement error might explain the lack of 100% mapping). Thus, this indicates the accounting properties of the exercise we are doing: exchange rates fully reflect balance sheets. By removing some of the components, as we do in this paper, we can test the relevance of particular elements (in this paper the focus is on RDL).

To conclude this section, we check the importance of "External Liabilities" in the exchange rate dynamics. For this we consider two additional CER measures that include the foreign liabilities. These are the "CER Base with Foreign Debt" and "CER Full with Foreign Debt" as depicted in Figure (A1). The foreign liabilities will be reflected in the denominators of the CER measures in a similar way as in Equation (15). We can see in the Figure that after this inclusion the CER measures barely change. In effect, the CER Base and CER Full are very similar to their counterparts that add external debt to the denominator. Hence, our abstraction of “External Liabilities" in this paper and our focus on RDL.

Figure A1: Monthly Spot Exchange Rate and CER, 2006-2019



Source: Authors' calculations using IMF IFS data.

C Additional Results of the Balance Sheet based VAR estimations

Table A4: Lag Selection for VAR models

Country	AIC(n)	HQ(n)	SC(n)	FPE(n)	Choice
Uruguay	2	1	1	2	2
Brazil	3	2	2	3	6
Peru	4	2	1	4	4
Chile	6	2	2	6	7
Paraguay	2	1	1	2	2
Mexico	4	1	1	4	4
Colombia	2	2	1	2	2

Note: The lag length is selected first according the AIC from a maximum of $T^{1/3}$ (6 for our sample size), and afterwards adjusted as necessary based on the residuals diagnostic tests.

Table A5: Johansen Cointegration Test Results, by Country

Number of Cointegration Relationships from Johansen Test						
Country	Deterministic Component			Decision by Type of Test		
	None	Const	Trend	Trace	Max. Eigenv.	Final Model (selected)
Uruguay	0 / 0	1 / 1	1 / 0	0 - None	0 - None	VAR (Differences)
Brazil	2 / 2	3 / 1	1 / 1	1 - Trend	1 - Const	VEC/VAR (Levels)
Peru	1 / 1	1 / 1	1 / 1	1 - None	1 - None	VEC/VAR (Levels)
Chile	1 / 1	3 / 2	1 / 1	1 - None	1 - None	VEC/VAR (Levels)
Paraguay	1 / 0	4 / 1	0 / 0	0 - Trend	0 - None	VAR (differences)
Mexico	1 / 0	2 / 0	1 / 1	1 - None	0 - None	VAR (Differences)
Colombia	2 / 2	3 / 3	2 / 2	2 - None	2 - None	VEC/VAR (Levels)

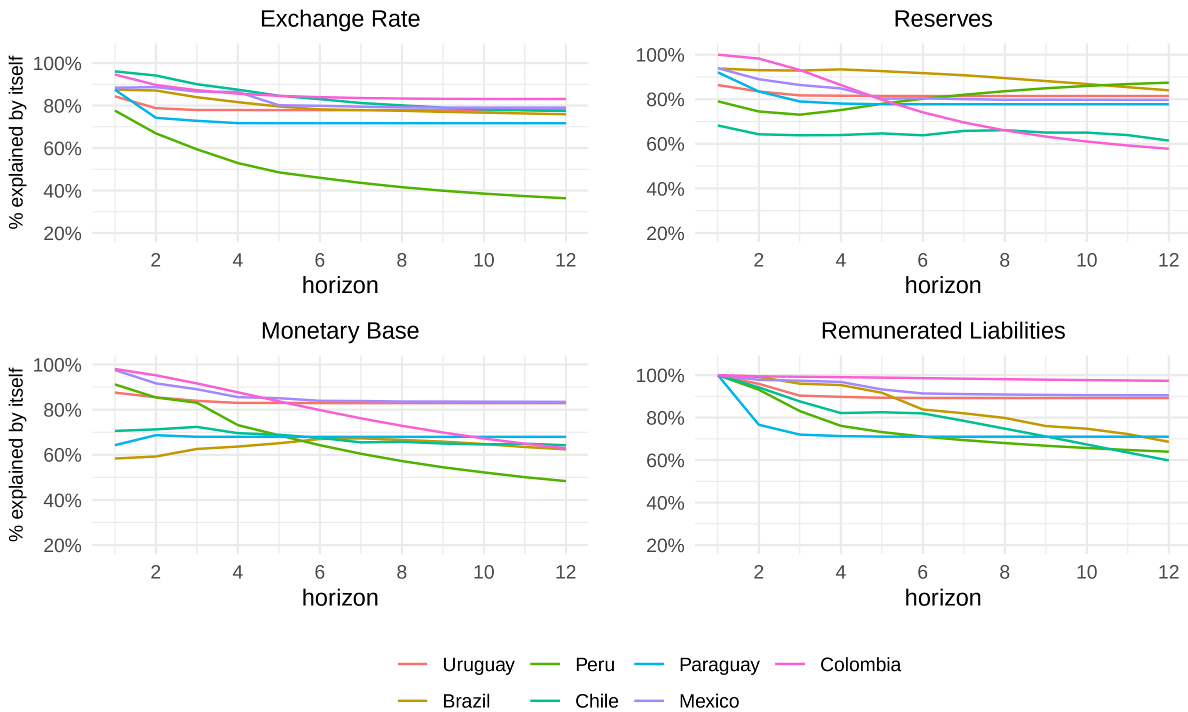
Notes: Each entry denotes the number of relations in the trace test / maximum eigenvalue test. The deterministic component refers to additional terms included in the cointegration relationship. The simplest model is selected (in number of relations and deterministic component(s)) for which the test is rejected. Here, as a robustness check, we replicate the cointegration test with 'none' as an additional setup option (no deterministic component in the cointegration relationship). The conclusions, in terms of the final model of choice, are similar.

Table A6: Causality Tests in the VAR models, by Country

Instantaneous Causality Test					Granger Causality Test				
Country	*er*	*h*	*mb*	*rdl*	Country	*er*	*h*	*mb*	*rdl*
Uruguay	0.000	0.000	0.000	0.000	Uruguay	0.058	0.068	0.000	0.438
Brazil	0.000	0.000	0.000	0.000	Brazil	0.008	0.000	0.124	0.151
Peru	0.000	0.000	0.003	0.000	Peru	0.030	0.000	0.001	0.012
Chile	0.109	0.000	0.000	0.000	Chile	0.239	0.064	0.000	0.014
Paraguay	0.000	0.000	0.000	0.000	Paraguay	0.026	0.023	0.577	0.005
Mexico	0.001	0.000	0.062	0.004	Mexico	0.001	0.120	0.008	0.854
Colombia	0.037	0.075	0.349	0.171	Colombia	0.000	0.000	0.040	0.301

Note: The null hypothesis is the variable in the column causes (instantaneously or Granger) the rest of the system. P-values are displayed in the table. The notation is as follows: exchange rate (*er*), foreign reserves (*h*), monetary base (*mb*), and remunerated domestic liabilities (*rdl*)

Figure A2: Percentage of variance each variable explained by itself: Spot Exchange Rate (upper left), Reserves (upper right), Monetary Base (lower left), and Remunerated Liabilities (lower right)



C.1 Robustness test: Alternative VAR model

Here it is shown the results of an alternative VAR model for the components of the balance sheet that includes an additional type of debt, namely the external liabilities (foreign debt) that represents the foreign counterpart of the RDL.

The ordering of the VAR model is similar to the baseline. However, now the first variable in the model are the external liabilities, the other four are set in the same order as the baseline: $X_t = [extliab \quad rl \quad h \quad mb \quad er]'$. The estimation is made based on a lower triangular impact matrix for the impulse responses (Cholesky), and $extliab$ denotes the external liabilities, or "liabilities to non-residents" in terms of the components in table A1.

Figure A3: FEVD for the Exchange Rate (upper left), Reserves (upper right), Monetary Base (lower left), and External Liabilities (lower right) (% explained by RDL)

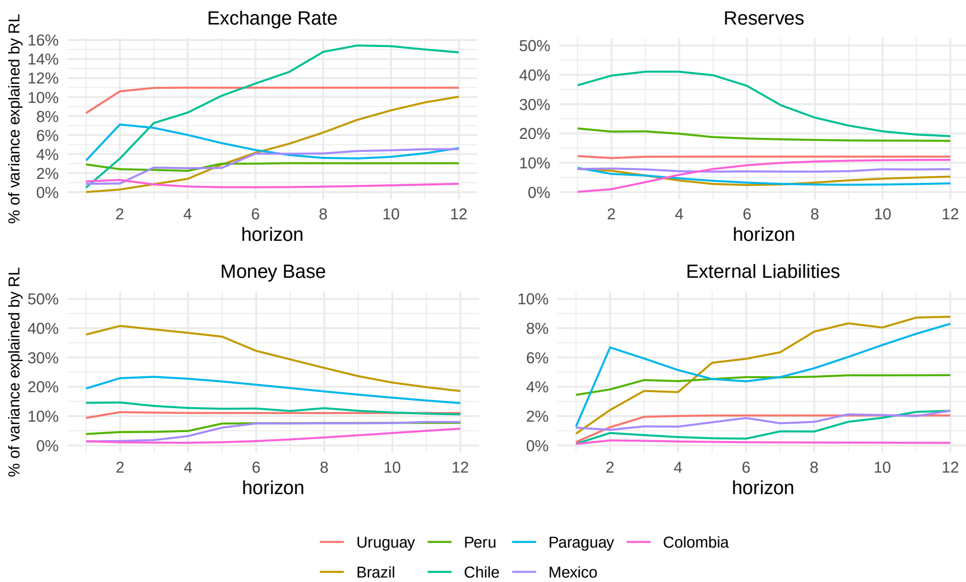
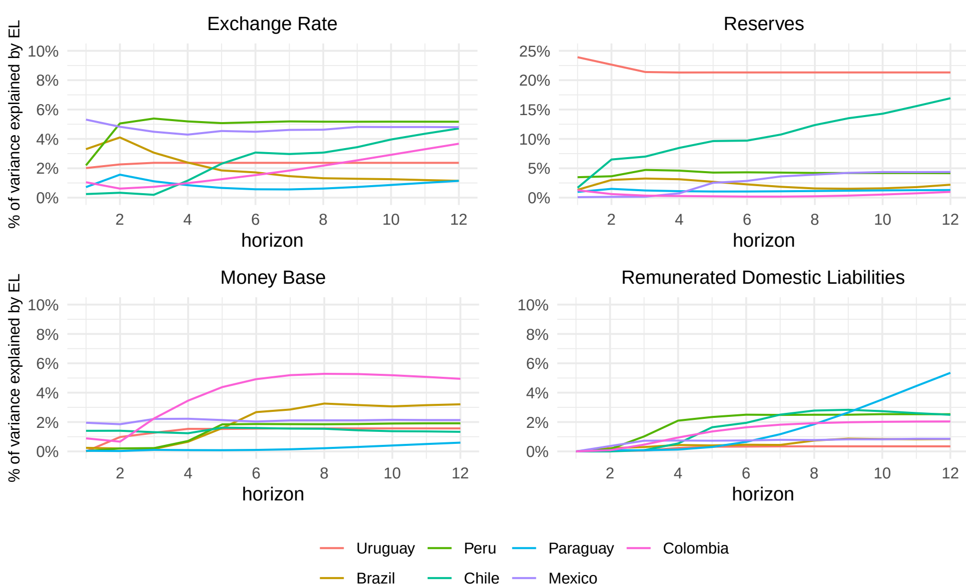


Figure A4: FEVD for the Exchange Rate (upper left), Reserves (upper right), Monetary Base (lower left), and RDL (lower right) (% explained by external liabilities)



D Additional Results from Threshold Cointegration Exercise

Table A7: Unit Root Test Results for Spot Exchange Rate (*er*) and Implied Exchange Rates (*Base* and *Full*), 2004:1-2019:12

Country and Exchange Rate	Level	Differenced	Country and Exchange Rate	Level	Differenced
Uruguay			Brazil		
Spot	-1.759	-7.681***	Spot	-2.183	-9.317***
Base	-2.510	-6.925***	Base	-1.373	-13.129***
Full	-1.250	-7.278***	Full	-3.140*	-4.118***
Chile			Paraguay		
Spot	-2.076	-10.154***	Spot	-1.655	-8.269***
Base	-2.112	-15.864***	Base	-2.467	-14.414***
Full	-1.444	-14.994***	Full	-1.096	-5.598***
Mexico			Colombia		
Spot	-2.551	-9.517***	Spot	-1.765	-9.022***
Base	-1.380	-15.520***	Base	-2.661	-5.647***
Full	-0.705	-14.807***	Full	-2.478	-6.220***

Notes: The null hypothesis is a unit root. Rejecting the null hypothesis for the level series and failing to reject the null hypothesis for the differenced series means the series is I(1). Input specifications for ADF unit root tests are: constant and trend for the level data; constant for the differenced data; lag length for the testing equation is selected by the AIC from a maximum of $T^{1/3}$. Significance at α = 0.10, 0.05 and 0.01 absence of a structural break. The CER Full for Brazil is considered I(1) because the test statistic for the level series is -3.140 and the α = 0.10 test statistic is -3.13.

Table A8: Pairwise Cointegration Results (with Adjustment Coefficients)

			Dependent variable: ΔY_t				Dependent variable: ΔX_t			
Case	Thresholds	Test Statistic	γ_1	γ_2	γ_3	γ_4	γ_5	γ_6	γ_7	γ_8
CER Base										
Uruguay	3	19.389*	-0.117***	0.071	-0.581*	-0.242***	0.009	-0.069	-0.076	0.001
Brazil	1	17.520***	-0.032	-0.143***	-	-	-0.002	1.054	-	-
Peru	3	24.780**	-0.263***	-0.400**	0.224**	-0.165***	-0.011	0.046*	0.007	0.021
Chile	3	22.848**	-0.178***	-0.199**	-0.233*	-0.106***	-0.027	-0.100	1.544	-0.007
Paraguay	2	54.443***	-0.312***	-0.723***	-0.184**	-	0.036	0.006	-0.075	-
Mexico	3	12.521	-	-	-	-	-	-	-	-
Colombia	3	23.793**	-0.334***	-0.778***	0.206	-0.530***	-0.092	-0.040	-0.051	0.001
CER Full										
Uruguay	2	17.9175**	-0.033	0.404	-0.109*	-	0.019	-0.063	0.056	-
Brazil	2	20.760**	-0.113***	0.194	-0.138***	-	0.058*	0.022	0.100***	-
Peru	3	31.388***	-0.091	-0.657***	-0.064	-0.068	0.061***	-0.086	-0.035	-0.152***
Chile	1	10.033	-	-	-	-	-	-	-	-
Paraguay	3	23.587**	0.038	-0.486***	-0.094	-0.178***	0.078**	0.017	-0.114	-0.015
Mexico	1	5.431	-	-	-	-	-	-	-	-
Colombia	3	25.785***	-0.125**	-0.303***	0.116	-0.337***	-0.078	-0.146	-3.305	-0.019

Notes: The null hypothesis is no cointegration against an alternative of (threshold) cointegration. Input specifications for the threshold cointegration tests: threshold locations include the middle 90% of observations divided into 50 increments; each regime requires a minimum of 24 observations (binds for 2 of 14 pairs); AIC used throughout; critical values for the threshold cointegration test simulated following the residual-based block bootstrap methodology by Seo (2008) with a block length of 6 and 999 replications under the null. Significance at α = 0.10, 0.05 and 0.01 denoted by *, **, and *** respectively.

E Additional Plots and Tables

Table A9: Balance Sheet Components as a fraction of GDP, 2017

Country	Reserves	Mon. Base	RDL	Ext. Liab.	Net Fin. Claims	Net Dom. Credit
Thailand	0.42	0.11	0.29	0.01	0.01	-0.02
Uruguay	0.24	0.05	0.20	0.02	-0.02	0.05
Israel	0.37	0.12	0.18	0.07	0.03	-0.03
Brazil	0.19	0.10	0.17	0.01	-0.01	0.10
Peru	0.30	0.08	0.14	0.00	0.02	-0.10
Dominican Rep.	0.09	0.09	0.13	0.02	0.01	0.14
Argentina	0.08	0.08	0.12	0.03	0.00	0.14
Chile	0.14	0.06	0.11	0.00	0.03	-0.00
Mauritius	0.38	0.18	0.11	0.00	-0.04	-0.07
Korea, Rep. of	0.21	0.08	0.10	0.03	0.02	-0.02
Jordan	0.39	0.26	0.10	0.03	0.01	-0.01
Nigeria	0.09	0.05	0.09	0.02	0.02	0.00
Mongolia	0.14	0.12	0.09	0.17	0.14	-0.01
China, P.R.: Macao	0.51	0.10	0.08	0.00	-0.07	-0.26
Azerbaijan, Rep. of	0.18	0.14	0.08	0.01	-0.06	-0.03
Belarus, Rep. of	0.12	0.05	0.07	0.02	0.08	-0.07
Paraguay	0.20	0.11	0.06	0.01	0.02	-0.04
Philippines	0.25	0.17	0.05	0.00	-0.03	0.00
Botswana	0.46	0.04	0.05	0.01	-0.17	-0.20
North Macedonia, Republic of	0.27	0.13	0.05	0.04	-0.02	-0.03
Seychelles	0.36	0.16	0.05	0.04	-0.02	-0.11
Indonesia	0.12	0.08	0.04	0.00	-0.02	0.02
Moldova, Rep. of	0.26	0.20	0.04	0.03	-0.03	0.05
Guatemala	0.15	0.14	0.04	0.01	0.01	0.02
Romania	0.20	0.10	0.02	0.02	0.00	-0.06
China, P.R.: Hong Kong	1.23	0.63	0.02	0.04	-0.08	-0.52
Cabo Verde	0.33	0.32	0.02	0.01	-0.02	0.03
Ukraine	0.19	0.13	0.02	0.12	-0.03	0.10
Mexico	0.15	0.06	0.02	0.00	0.01	-0.08
Australia	0.05	0.04	0.02	0.00	0.03	-0.02
Kyrgyz Rep.	0.27	0.19	0.01	0.02	-0.03	-0.02
Rwanda	0.11	0.04	0.01	0.03	-0.01	-0.02
St. Lucia	0.15	0.13	0.01	0.01	0.01	-0.00
Serbia, Rep. of	0.26	0.13	0.01	0.00	-0.07	-0.05
Kenya	0.09	0.05	0.01	0.01	-0.01	-0.02