Currency Mismatch in the Banking Sector in Latin America and the Caribbean*

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Existing literature uses data based on the residence principle to proxy for currency mismatch. Nonetheless, these data are frequently not disaggregated by currency and cannot identify mismatches in the domestic market. This paper circumvents these issues by constructing a new data set on foreign currency assets and liabilities in the banking sector in Latin America and the Caribbean. The new data reveal a reduction in long foreign currency positions, with several countries taking short positions after 2006. Moreover, employing a methodology that accounts for time-varying unobservable characteristics, this reduction is shown to be partially explained by the implementation of prudential policies.

JEL Codes: G18, G21, F30.

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1. Introduction

The most recent crisis reminded us of the importance of dampening foreign currency risk (see Terrier et al. 2011).[1] Indeed, unexpected movements in the exchange rate may have negative impacts on the balance sheet and, through this channel, amplify risks for financial stability. These risks are particularly relevant in regions with high levels of financial dollarization, such as Latin America and the Caribbean, but despite this fact, insufficient data collection currently exists to properly measure currency mismatches in these economies. As such, the contribution of this paper is twofold. First, it constructs a unique data set to measure currency mismatches in the banking sector in Latin America and the Caribbean by conducting a survey across seventeen central banks from the region. Second, the paper uses this unique data set to evaluate the effects of prudential policies, employing the synthetic control method (Abadie and Gardeazabal 2003 and Abadie, Diamond, and Hainmueller 2010), which, to the best of my knowledge, has never been used to this end.

The contemporary economic history of the Latin American and Caribbean countries has been characterized by periods of high inflation and currency crises. In most countries, these crises reduced confidence in local currencies and, therefore, induced residents to substitute them with U.S. dollars. Indeed, in the majority of Latin American and Caribbean economies, the public began to save, borrow, and lend in U.S. dollars, leading to a process of financial dollarization (see Álvarez-Plata and García-Herrero 2007).[2]

In turn, financial dollarization is frequently associated with currency mismatches and, therefore, entails significant amounts of financial risk (foreign currency exposure also entails benefits such as international risk sharing; nonetheless, these are beyond the scope of this study).[3] In the presence of currency mismatches, unexpected

[1]Terrier et al. (2011) highlight the relevance of currency mismatches in Eastern Europe during the crisis.

[2]The banking sector in Latin America and the Caribbean still is among the most financially dollarized banking sectors in the world (Álvarez-Plata and García-Herrero 2007).

[3]For instance, Devereux and Sutherland (2009) show in a DSGE model that an emerging economy can achieve international risk sharing by optimally holding foreign currency nominal bonds and issuing claims on capital. In a similar vein, the DSGE model is optimal and achieves risk sharing.

movements in the exchange rate can trigger negative impacts on the balance sheet, and these impacts can propagate throughout the economy, putting financial stability at risk. Furthermore, in the past, this risk has been propagated to a large extent by banking institutions (see, for instance, Corsetti, Pesenti, and Roubini 1999; Krugman 1999; Céspedes, Chang, and Velasco 2000; Aghion, Bacchetta, and Banerjee 2001; and Allen et al. 2002), which emphasizes the need for appropriately measuring currency mismatches in the banking sector, particularly in Latin America and the Caribbean.

This need has been partially addressed by a literature that has constructed different classes of currency mismatch indicators.[4] The earliest measures in this literature are known as original sin indicators and have been criticized for ignoring the asset side of the balance sheet, i.e., although FX assets can be used to hedge foreign currency risk, they are not considered by the original sin indicators. In response to this flaw, measures that look at both sides of the balance sheet could be used, such as the external vulnerability indicators.

However, these indicators have the problem of using data based on the residence principle, which are frequently not disaggregated by currency of denomination (e.g., balance-of-payment data). Moreover, these data are aggregated at the country level and are, thus, unable to identify mismatches in the domestic market. Hence, the use of country-level data based on the residence principle is even more inappropriate in cases in which residents establish foreign currency relationships on a regular basis (e.g., financially dollarized), such as in Latin America and the Caribbean.

In order to circumvent these issues, this paper collects data on foreign currency assets and liabilities in the private banking sector from financially dollarized economies. The data refer to both sides of the balance sheet, are disaggregated by currency of denomination, and are collected at the sectoral level. Furthermore, because the data collection process has been based on accounting manuals for banking institutions, the information is comparable at the highest possible level across seventeen Latin American and Caribbean countries.

[4]Lane and Shambaugh (2010a, 2010b) should also be considered in this literature. See section 2 for details.

Given these advantages, the paper uses the data to construct two indicators that capture different dimensions of currency mismatch. While the first indicator measures the average level of currency mismatches in a given country and during a given time period, the second indicator informs on whether foreign currency positions have been long or short on average. The behavior of these indicators across countries and over time reveals novel facts.

First, banking sectors with higher levels of currency mismatch were more exposed to foreign currency risk over 2000–12 for two reasons: (i) their currency mismatches were greater on average and (ii) they took more extreme values. Second, there was a reduction in long foreign currency positions in most banking sectors in Latin America and the Caribbean. Third, the trend of the ratio of FX assets to FX liabilities went from increasing to decreasing, and short positions were taken in several banking sectors, mostly after 2006.

The currency mismatch indicators and the synthetic control method are used to investigate the effects of prudential policies (Abadie and Gardeazabal 2003 and Abadie, Diamond, and Hainmueller 2010). The synthetic method controls for unobservable characteristics that vary over time and, therefore, circumvents issues with the standard difference-in-differences techniques (see section 5 for the relevance of unobservable characteristics in evaluating prudential policies). As such, this paper focuses on a policy that is relevant for financially dollarized economies: it investigates the effects of reductions in the limit on long foreign currency positions and of increases in the limit on short positions.

The results suggest that these policies reduced long positions and the average level of currency mismatch in Bolivia, Paraguay, and Peru. On average, over five post-intervention quarters, the policies diminished the ratio of FX assets to FX liabilities by between 1.78 and 2.66 percent, depending on which countries are considered in the construction of the mean.

The study is related to an emerging literature that investigates the effects of FX macroprudential policies on different dimensions of financial risk. For instance, Dell'Ariccia et al. (2012) find that macroprudential tools reduced the probability of credit booms in twenty-two Central and Eastern European countries over 1985–2009. Ostry et al. (2012) show that tighter FX prudential measures are associated

with reductions in domestic foreign currency borrowing. Moreover, Lim et al. (2011) show that limits on foreign lending reduce the procyclicality of leverage, and that limits on net open foreign positions reduce external indebtedness. In contrast with these studies, the present paper constructs measures of currency mismatch by using data disaggregated by currency of denomination on all components of the balance sheet. Furthermore, it uses the synthetic control method and considers as a treatment group the set of countries that have not modified their limits on FX positions.

Finally, some other points are worth mentioning. The currency mismatch indicators that I construct measure the exposure to FX risk that can be inferred from banks' balance sheets. I do not claim in this study that this is all the FX risk that banks face. For instance, the banking sector also faces risk associated with lending to unhedged borrowers (FX credit risk in the terms of Terrier et al. 2011) or with financial instruments that do not appear in the balance sheet (see section 3 for a discussion on the relevance of derivatives). Nevertheless, I believe that both the data set and the indicators that I construct represent a significant improvement over existing literature and contribute to understanding how currency mismatches behave. Furthermore, given that most FX policies in the region apply to the banking sector, the data on banks' balance sheets allow me to perform policy analysis.

The remainder of this paper is structured as follows. Section 2 reviews the literature on currency mismatch indicators. Section 3 explains the main features of the data collection process. Section 4 analyzes the behavior of the constructed indicators across countries and over time, and section 5 performs policy analysis. Finally, section 6 concludes.

2. Currency Mismatch Indicators: Aggregate and Sectoral Levels

The economic crises of the mid and late 1990s involved abandonments of currency pegs and sharp devaluations of local currencies. As such, these crises raised interest among scholars in understanding the nature and implications of foreign currency risk and, therefore, in appropriately measuring currency mismatches. In turn, this interest generated a first generation of indicators that measured

currency mismatches by using data disaggregated at the country level.

The canonical measures in this first generation were the so-called original sin indicators. These measures were based on the idea that currency mismatch was the result of a country's inability to borrow abroad in its own currency (its "original sin"; see Eichengreen and Hausmann 1999; Hausmann, Panizza, and Stein 2002; and Eichengreen, Hausmann, and Panizza 2003).[5] In this context, the level of currency mismatch in a given economy could be explained by its issuance of foreign currency debt; for instance, some of these indicators argued that original sin and currency mismatch were decreasing in the amount of foreign-currency-denominated securities issued in a country relative to its total debt.

Although the original sin indicators played a pioneering role in literature, their use as proxies for currency mismatch was quickly criticized. The argument was that these indicators considered only the liabilities side of the balance sheet, despite the fact that FX risk could be hedged through purchases and sales of foreign currency assets (Goldstein and Turner 2004). In order to overcome this criticism, one could, in principle, substitute the original sin indicators with measures of external vulnerability. These measures were also constructed at the aggregate level; they considered both sides of the balance sheet and proved powerful for predicting financial crises (Goldstein and Turner 2004).

Nonetheless, the use of external vulnerability indicators as proxies for currency mismatch presents an important flaw. Particularly, these measures employ data based on the residence principle, which are frequently not disaggregated by currency of denomination and are, as a result, inadequate for measuring currency mismatches (Bussière and Mulder 1999 and Goldstein and Turner 2004). In this sense, it may be useful to replace the external vulnerability indicators with the measure developed by Lane and Shambaugh (2010a) to assess the valuation impact of currency movements. This indicator represents an improvement, relative to both the original sin and the external vulnerability indicators, given that it considers the two

[5]In a context in which countries cannot borrow abroad in their own currency, mismatches arise, for instance, because the revenues of most firms are denominated only in this currency.

sides of the international balance sheet and uses data disaggregated by currency of denomination.[6]

However, the problem with this approach is that the measure developed by Lane and Shambaugh (2010a) is based on data aggregated at the country level. Indeed, these data are unable to identify mismatches in the domestic market, given that, in the process of aggregation, long and short foreign currency positions of different residents cancel each other out. Hence, information aggregated at the country level is insufficient for measuring currency mismatches, and this is particularly true for the case of financially dollarized economies, in which residents save, borrow, and lend in foreign currency (Goldstein and Turner 2004 and Rancière, Tornell, and Vamvakidis 2010).

Consistent with this idea, recent literature emphasizes the need to account for currency mismatches in the domestic market by using data disaggregated at the sectoral level. For instance, Allen et al. (2002) emphasize this need by arguing that although foreign currency debt may originate local mismatches, information on this debt is absent in aggregate data. Further, Reinhart, Rogoff, and Savastano (2003) highlight the lack of reliable data to calculate linkages at the sectoral level, thus indicating that data unavailability hinders progress in the literature.

In this context, the present paper constructs currency mismatch indicators that incorporate the improvements in the literature on aggregate measures but, more importantly, use data disaggregated at the sectoral level. That is, these currency mismatch indicators consider both sides of the balance sheet (just as the external vulnerability indicators do); they are based on data disaggregated by currency of denomination (in the manner of Lane and Shambaugh's 2010a indicator) and are constructed at the banking-sector level, thus addressing the concerns raised by recent literature.

In fact, this is not the first attempt to construct currency mismatch indicators for the banking sector; there have been other

[6]The goal of Lane and Shambaugh (2010a) is to quantify the valuation channel. Nonetheless, its characteristics make it suitable for using it as a proxy for currency mismatch. Along the same lines, Lane and Shambaugh (2010b) provide stylized facts on cross-country and time-series variation in aggregate foreign currency exposure.

attempts that do not necessarily incorporate all improvements in the literature on aggregate indicators. For instance, using annual data on foreign currency deposits and loans for thirty-seven countries, Arteta (2005) shows that currency mismatches are greater under exchange rate flexibility. In contrast with the present work, his paper uses data only on specific components of the balance sheet, i.e., credit and loans. Moreover, it employs information up to 2000 and does not investigate the effects of prudential policies. In a different study, Prat (2007) constructs indicators for the banking sector in twenty-five emerging countries, and finds that currency mismatches play a significant role for the determination of emerging sovereign bond spreads. However, her sample does not include most countries with a high degree of financial dollarization considered in the present study (see Goldstein and Turner 2004). Additionally, she uses data up to 2005, does not study the behavior of currency mismatch across countries and over time, and does not evaluate the effects of policy interventions.

Finally, Rancière, Tornell, and Vamvakidis (2010) construct a measure of currency mismatch that controls for bank lending to unhedged borrowers to capture systemic risk. Their measure is constructed for ten European economies and subsequently for another nineteen emerging countries. In this last exercise, they are forced to use data based on the residence principle for most considered Latin American economies. In their own words, the data collection effort in Eastern Europe "seems unparalleled in the rest of the emerging world, despite the role of currency mismatch in the financial crises of the 1990s" (Rancière, Tornell, and Vamvakidis 2010, p. 9). By collecting data on foreign currency assets and liabilities for the banking sector in Latin America and the Caribbean, the present paper fills this gap.

3. Collecting Data and Making It Comparable

3.1 Data Collection Process

The data set presented in this paper was constructed on the basis of a survey that I ran across central banks from Latin American and the Caribbean. The survey had two goals. First, it aimed at generating comparable information that can be easily accessed by the

central banks.[7] Comparability and accessibility would make the data suitable for performing cross-country comparative studies. Second, it studied financial risks arising from movements in the exchange rate, as well as policies implemented to minimize these risks. Hence, the survey requested information on foreign currency assets and liabilities and on the goals and implementation characteristics of prudential policies and capital flow management measures (see the appendix for a full description of the survey).

This information was collected in two stages. The first stage was launched in November–December 2012, when the project was announced and the survey sent to the chiefs of the research and financial stability departments in each central bank.[8] Having received the survey, they decided how to distribute the questions among the different departments within their institution, i.e., so that each question would be answered by the best-qualified person. The second stage enabled me to gain a better understanding of the answers, as well as of the economic context in which the policies were implemented, by complementing the information provided in the first delivery of the survey. This second stage comprised a series of contacts made by e-mail or by phone and personal interactions that I maintained with officials from several central banks.

The two stages of the data collection process were designed and implemented to ensure that both goals of the survey were fulfilled. Regarding the first goal, comparability has been guaranteed by the fact that the process was based on the accounting manual for banking institutions from different countries and that officials from all central banks played a proactive role in the construction of the data set (see the next subsection for more details). Moreover, given that researchers from these banks could access the information on foreign currency assets and liabilities, accessibility has also been guaranteed, ensuring that the first goal of the survey was fully achieved. Specifically, the data were uploaded on a website and the security keys for accessing them distributed to the chief economists of the

[7]The Central Bank of Venezuela delivered data on foreign currency assets and liabilities, but at the moment this paper was being written, it had not been analyzed.

[8]The project was announced to the heads of the research departments at the XVII Meeting of the Central Bank Researchers Network of the Americas, held in Montevideo, Uruguay, on November 21–23, 2012.

central banks.[9] Regarding the second goal, the one referring to risks associated with movements in the exchange rate and policy interventions, the answers to the corresponding questions exceed the scope of this study and have been systematized in related studies (Tobal 2014 and Tobal, forthcoming).

3.2 Making Data Comparable

The two stages of the collection process were designed to ensure the highest possible level of comparability across countries. Particularly, I imposed two conditions that guaranteed cross-country comparability in the data on foreign currency assets and liabilities. I ensured that the information provided by each central bank referred to (i) a similar set of financial agents and (ii) a similar set of foreign currency assets and liabilities.

The heterogeneity across countries allowed defining the set of agents from which the data would be requested by using the two steps of the process. Because the financial systems were heterogeneous, it was a priori difficult to find a single set on which all central banks could provide data and that was, at the same time, sufficiently representative for each country. Given these considerations, I inquired about data on the "banking sector" in the first stage of the process and, then, using this information, redefined the set of agents by discussing the idiosyncratic characteristics of each country with experts from the central banks. Officials from the central banks were better qualified than myself to point out differences and similarities between their financial system and others in the region and, therefore, to judge whether a set of agents was representative for their countries.

As a result, I defined the set of financial agents as "commercial banks," given that the majority of countries were able to deliver data on these agents and that most central banks agreed that this set was representative enough. The remaining central banks provided information for at least a "similar but slightly more aggregated" set, and were asked which proportion they thought commercial banks

[9]The security keys for accessing the database were distributed at the XVIII Meeting of the Central Bank Researchers Network of the Americas, held in Mexico City, México, on November 11–13, 2013.

Table 1. Commercial Banks in Delivered Set

Country	Proportion of Commercial Banks in Delivered Set
Argentina	99
Aruba	100
Bolivia	100
Brazil	NA
Chile	100
Colombia	100
Costa Rica	100
Dominican Republic Countries	NA
Eastern Caribbean	100
Guatemala	100
Honduras	100
Jamaica	75
Mexico	NA
Nicaragua	100
Paraguay	96
Peru	100
Uruguay	100

Sources: National authorities.

represented in this set (for those countries that delivered data on a more aggregated set, table 1 lists the proportion that the delivered information represents in "commercial banks"). Indeed, according to their view, commercial banks represent a substantial portion of most financial systems, guaranteeing that the data were also representative in these cases.

The second condition I imposed on the collection process ensured that the data referred to a similar set of assets and liabilities. To fulfill this condition, I guided the central banks in the process of data delivery by explicitly providing them with categories of foreign currency assets and liabilities. Providing officials with specific categories forced them to deliver data on similar concepts and, most importantly, made it harder for them to exclude relevant information.

In creating these categories, I contacted officials from the Banco de la República, Colombia. These officials helped me create five categories of assets and liabilities and linked each foreign currency account from Colombia's accounting manual to one of them. Subsequently, I used this link between accounts and categories as a benchmark for the remaining countries: employing the accounting manual of each country, I linked the accounts of each nation's manual to a Colombian foreign currency account and, therefore, to one of the five categories created by the Banco de la República.[10]

The link between foreign currency accounts and categories I created was then sent to the remaining central banks as a guide for data delivery in the second stage of the process. In this stage, central banks were told that they were free to use the link I had created for their country or could create their own by using the link that the Banco de la República, Colombia, had generated.[11] The fact that central banks were aware of Colombia's example and had the freedom to use it as a benchmark for creating their own link precluded misinterpretations. Indeed, the fact that officials from the central banks played a proactive role in this step of the process is reassuring, given that they are highly qualified to understand differences and similarities between their financial system and others.

3.3 Collected Data

Central banks from seventeen Latin American and Caribbean countries delivered the requested data: Argentina, Aruba, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, the Eastern Caribbean countries, Guatemala, Honduras, Jamaica, México, Nicaragua, Paraguay, Peru, and Uruguay. The time span of interest was defined as 1992:Q2–2012:Q2, but, knowing that the information would not be available over the entire period for all central banks, I asked them to provide as much information as possible. Furthermore, central banks were told to provide data with a quarterly frequency.

[10] For non-Spanish-speaking countries, I employed Monaco's accounting manual as a benchmark, because its structure is similar to that proposed by the Banco de la República, Colombia.

[11] At this stage, it was emphasized that, even if they created their own allocation, they had to deliver data on all the foreign currency assets and liabilities that appeared in Colombia's example.

Table 2. Data Collected in the Survey

Country	Data Available For:
Argentina	1999:Q4–2012:Q3
Aruba	1999:Q1–2012:Q4
Bolivia	2000:Q1–2012:Q4
Brazil	2001:Q1–2012:Q4
Chile	1992:Q1–2012:Q4
Colombia	2000:Q1–2012:Q3
Costa Rica	1999:Q4–2012:Q3
Dominican Republic Countries	2000:Q4–2012:Q4
Eastern Caribbean	1992:Q1–2012:Q1
Guatemala	2001:Q2–2012:Q2
Honduras	1998:Q1–2012:Q4
Jamaica	2000:Q1–2012:Q4
Mexico	2000:Q4–2012:Q3
Nicaragua	2003:Q1–2012:Q3
Paraguay	1995:Q1–2012:Q3
Peru	2001:Q1–2012:Q4
Uruguay	1999:Q4–2012:Q4

Sources: National authorities.

In fact, the seventeen countries that delivered information provided quarterly data. The time span for which the information was delivered varied substantially across central banks, along with data availability. For example, while in Chile, Paraguay, and the Eastern Caribbean countries the requested data were available for more than seventy quarters, Nicaragua delivered information on thirty-nine quarters. With the exception of Brazil, Peru, and Nicaragua, whose samples commence in 2001 (Brazil and Peru) and in 2003 (Nicaragua), all countries delivered data starting in the year 2000 or even before that. Table 2 summarizes the time span of the delivered data for each country.

Regarding the set of financial agents upon which the data was delivered, table 1 lists the central banks that delivered information on "commercial banks." For countries that did not deliver information on this specific set, table 1 also shows the proportion that

"commercial banks" represent in the delivered data (this information is self-reported and, thus, based on the perceptions of central banks' officials). Particularly, this table shows that only Argentina, Jamaica, and Paraguay provided information on a set of financial agents larger than the requested one. Therefore, in these three countries, the information cannot be separated into data on commercial banks and data on other financial institutions. Nonetheless, according to central bank officials, the set of "commercial banks" represents over 95 percent of the data in Argentina and Paraguay and 75 percent of the data in Jamaica. The information delivered by Jamaica contains data on two types of deposit-taking institutions that are not "commercial banks": building societies and FIA licensees (institutions with licensees operating under the Financial Institutions Act).

3.4 Flaws in the Data: Financial Derivatives

A drawback of the collected data is that they do not contain all the information required for a full assessment of foreign currency risk. In particular, the data do not contain information on the amount or the nature of financial derivatives. Nonetheless, given that banks may use them to hedge against foreign currency risk, the information is, in principle, relevant to appropriately measure currency mismatches. For example, Goldstein and Turner (2004) note that the lack of information on derivatives is a major flaw of the original sin indicators.

Indeed, the fact that this information is frequently not required to appear in the balance sheet makes it particularly difficult to obtain for most countries. The implication is that Goldstein and Turner's criticism (2004) applies not only to the original sin indicators but also to most existing indicators on currency mismatch. That is, data unavailability on financial derivatives has hindered the construction of most currency mismatch indicators for most economies.

For the case of Latin America and the Caribbean countries, the fact that the information is generally off balance sheet explains why most central banks were unable to provide data on derivatives when delivering the survey. Furthermore, even in those countries in which the information appears in the balance sheet, accounting manuals

Table 3. Development of Financial Derivatives Market

Country	(Derivatives Assets + Derivatives Liabilities)/(Assets + Liabilities)	Period
Chile	0.0370	2010:M1–2013:M7
Colombia	0.1217	2000:Q1–2012:Q3
Nicaragua	0.0007	2008:M1–2013:M6

Sources: National authorities and author's calculations.

tend not to make a relevant distinction between different types of derivatives for the purpose of the present study, i.e., in most Latin American and Caribbean countries, these manuals do not distinguish between derivatives that can, in principle, be used to hedge against foreign currency risk and other types of derivatives.

Furthermore, although using information on financial derivatives is relevant from a conceptual point of view, in practice, not counting with these data may be less critical for the particular case of Latin America and the Caribbean. Precisely, the fact that derivatives markets are relatively less developed in the region makes the lack of information less important. Table 3 supports this point by constructing a proxy for the development of derivatives markets as the ratio of derivatives to the sum of total assets and liabilities in a given country, regardless of currency of denomination.

The proxy is shown for the three economies that delivered information on derivatives. The Central Bank of Chile provided monthly data from January 2010 to July 2013, the information available for Nicaragua is from January 2008 to June 2006, and the Banco de la República, Colombia, delivered quarterly data from 2000 to 2012. Note that the ratio of derivatives to the sum of total assets and liabilities equals 0.0007 and 0.037 for Nicaragua and Chile, respectively, indicating that their derivatives markets are relatively low and moderately developed. The ratio is 0.1217 for Colombia, where the financial derivative market is more developed than in the other two countries. In summary, whereas information on FX derivatives is critical from a conceptual point of view, not having this information is less important for Latin America and the Caribbean in practical terms, because derivatives markets in this region are relatively underdeveloped.

4. Currency Mismatch Indicators

This section presents two indicators that capture different dimensions of currency mismatch in the banking sector. The first indicator is written as follows:

$$CMABS(iT) = \left[\sum_{t=0}^{t=T} |CM(it) - 1|\right] \Big/ T,$$

$$CM(it) = FXAssets(it)/FXLiabilities(it), \tag{1}$$

where $FXAssets(it)$ and $FXLiabilities(it)$ are foreign currency assets and liabilities held by the banking sector in country i at quarter t, $CM(it)$ is the ratio between these assets and liabilities, $|.|$ denotes absolute value, the first quarter has been normalized to 0, and $CMABS(iT)$ is the mean of $|CM(it)-1|$ over time. The consideration of absolute values makes $CMABS(iT)$ silent on whether there is a short or a long foreign currency position. On the other hand, it ensures that these positions do not cancel each other out, and, therefore, that $CMABS(iT)$ reflects the average level of currency mismatch over a period.

Table 4 and figure 1 show the mean and the standard deviation of $|CM(it) - 1|$ over the period 2000–12 for the seventeen countries.[12] The cross-country correlation between the mean and the standard deviation is positive and strong (the correlation coefficient is 0.925 for the seventeen countries). Thus, the countries with higher $CMABS(iT)$ were more exposed to foreign currency risk for two reasons: (i) their currency mismatches were greater on average and (ii) these mismatches were more extreme.[13]

[12]Twelve countries have data available for 2000 and four of the remaining economies have data available starting a year later; therefore, I start the sample with 2000. For the remaining countries, the period considered begins in the first available quarter. For all countries, the period ends in the last available quarter.

[13]Chile, on one hand, is the country with the highest $CMABS(iT)$; the moments of pegged float are associated with an accumulation of long positions in this country (see the appendix for a description of the mismatch trend).

Table 4. Absolute Value Indicator of Currency Mismatch

Country	$CMABS(iT)$*	Standard Deviation**
Bolivia	0.0415	0.0200
Paraguay	0.0474	0.0385
Uruguay	0.0520	0.0171
Peru	0.0673	0.0479
Dominican Republic	0.0701	0.0671
Honduras	0.0800	0.0224
Costa Rica	0.1077	0.0380
Mexico	0.1107	0.0426
Guatemala	0.1362	0.0598
Brazil	0.1497	0.0857
Argentina	0.2206	0.0842
Colombia	0.2824	0.1698
Aruba	0.2849	0.1052
Jamaica	0.3270	0.2776
Nicaragua	0.3333	0.2306
Eastern Carib. Countries	0.3429	0.2547
Chile	0.3500	0.2862

Sources: National authorities and author's calculations.
Notes: The sample begins in 2000 or in the first available quarter and ends in the last available quarter; *$CMABS(iT) = \left[\sum_{t=0}^{t=T} |CM(it) - 1|\right] \Big/ T$; **standard deviation of $|CM(it) - 1|$.

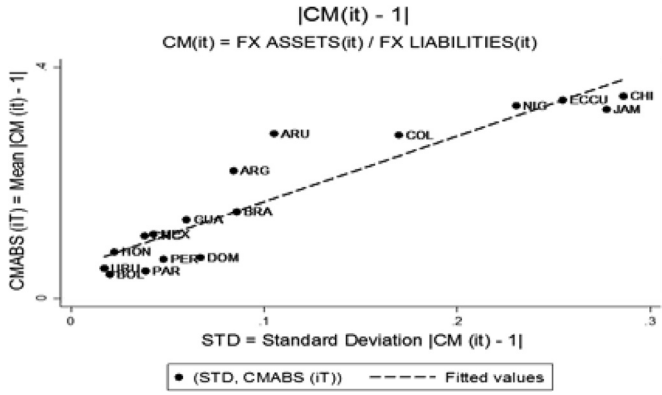
The second indicator is written as follows for a country i over a period of T quarters:

$$CM(iT) = \sum_{t=o}^{t=T} CM(it)/T, \tag{2}$$

where $CM(iT)$ is the mean of $CM(iT)$ over time. This second indicator reflects whether the foreign currency position taken by banks is on average long or short. $CM(iT) > 1$ indicates that the average position is long, and $CM(iT) < 1$ indicates that this position is, on average, short.

Table 5 and figure 2 show rates of change in $CM(iT)$ by country over time. The rate of change is calculated as the

Figure 1. Absolute Value Indicator of Currency Mismatch



Sources: National authorities and author's calculations.
Notes: The sample begins in 2000 and ends in the last available quarter for each country. For the four countries with no data available for the first the period of 2000, the sample starts with the first available quarter. The countries considered in the figure are ARG (Argentina), ARU (Aruba), BOL (Bolivia), BRA (Brazil), CHI (Chile), COL (Colombia), CRC (Costa Rica), DOM (Dominican Republic), ECCU (Eastern Caribbean Countries), GUA (Guatemala), HON (Honduras), JAM (Jamaica), MEX (Mexico), NIC (Nicaragua), PAR (Paraguay), PER (Peru), and URU (Uruguay).

log-difference between an initial mean (the average of $CM(iT)$ over 2001:Q2–2002:Q1) and a final mean (the average of $CM(iT)$ over 2011:Q3–2012:Q2).[14] For twelve of the sixteen economies considered in table 5, the rate of change is negative, indicating that there was a reduction in long positions in most banking sectors in Latin America and the Caribbean.[15]

Furthermore, nine of these banking sectors took short foreign currency positions over 2000–12. For these countries, short and long positions partially cancel each other out and, therefore, $CM(iT) < CMABS(iT) + 1$. Tables 4 and 6 show that this inequality holds

[14]The rate of change is calculated between means to avoid a single observation driving the results. The periods 2001:Q2–2002:Q1 and 2011:Q3–2012:Q2 are chosen to calculate the means because all countries, with the single exception of Nicaragua, have data available for these periods.

[15]In table 4, the cross-country initial mean is 1.18 and the average of the final mean is 1.03. Figure 3 excludes Chile and Jamaica so as not to distort the scale of the graph.

Table 5. Change in Non-absolute Value Indicator of Currency Mismatch

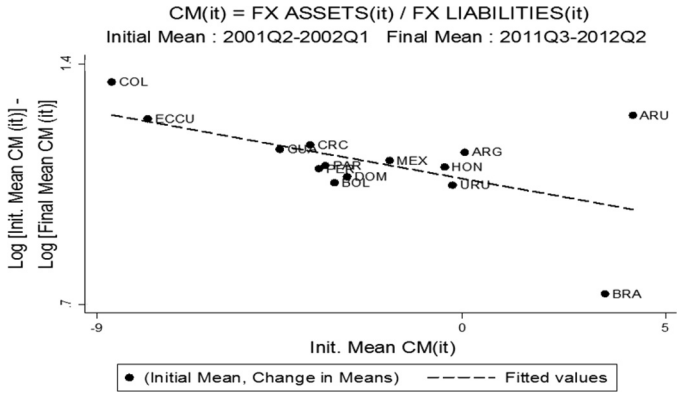
Country	Initial Mean*	Change in Means**
Brazil	0.730	3.52%
Uruguay	1.046	−0.24%
Bolivia	1.053	−3.14%
Dominican Republic	1.072	−2.83%
Peru	1.094	−3.52%
Honduras	1.100	−0.44%
Paraguay	1.104	−3.37%
Mexico	1.119	−1.79%
Argentina	1.143	0.06%
Guatemala	1.151	−4.49%
Costa Rica	1.164	−3.74%
Eastern Carib. Countries	1.241	−7.74%
Aruba	1.251	4.20%
Colombia	1.347	−8.62%
Chile	1.606	−33.90%
Jamaica	1.680	−19.89%

Sources: National authorities and author's calculations.
Notes: *Initial Mean: Average over 2001:Q2–2002:Q1. **Change in Means: Rate of change between the initial mean and the final mean, which is the average of $CM(it)$ over 2001:Q2–2002:Q1.

for Bolivia, Uruguay, Paraguay, Peru, Brazil, Chile, Colombia, the Dominican Republic, and the Eastern Caribbean countries. The time behavior of $CM(it)$ and its trend are represented in figures 3–11 for these economies (the Hodrick-Prescott filter is used to calculate the trends).[16]

[16]Note, in these figures, that Brazil is the only country with short positions in almost every quarter. However, pushed by the unification of the FX markets and the modification of reserve requirements on foreign currency positions, its $CM(iT)$ increased from 2001 to the late 2000s (I am grateful to officials from the Central Bank of Brazil for pointing this out during the BIS-CEMLA Round Table on FX market interventions). Chile, on the other hand, is the country with the highest $CM(iT)$. This can be partially explained by the accumulation of long positions over 1992:Q1–1999:Q3, when the pegged float regime led to several reductions in the price of the Chilean peso. Finally, $CM(iT)$ took extreme values in Uruguay and the Dominican Republic in 2003 and 2002, respectively, when these economies faced financial crises.

Figure 2. Non-absolute Value Indicator of Currency Mismatch



Sources: National authorities and author's calculations.
Notes: The rate of change is calculated between the initial mean (2001:Q2–2002:Q1) and the mean of the period that goes from 2011:Q3 to 2012:Q2. See figure 1 for abbreviations.

Note, in figures 3–11, that most short foreign currency positions were taken over the period that begins in 2007. Furthermore, from 2008 onward, all trends of currency mismatch indicators decreased monotonically (the only exceptions are a few quarters in Chile and Paraguay). In a similar vein, the figures show that there was a break in this trend between 2005 and 2008. Particularly, for most countries, this trend went from increasing to decreasing and reached its minimum over 2002–12, in either 2011 or 2012 for eight of the nine economies (the same pattern is observed in Uruguay if excluding the financial crisis of 2002). As a result, the reduction in long positions and the emergence of short positions are relatively recent phenomena. In other words, short foreign currency positions did not become common in Latin America and the Caribbean until the late 2000s.

Within the set of countries that took short positions, Bolivia, Uruguay, Paraguay, and Peru stand out with similar patterns. First, they are the economies with the four lowest values of $CMABS(iT)$ and four of the five lowest values of $CM(iT)$ (the smallest currency mismatches and the shortest positions, on average). Second, the reduction in their long position was among the greatest over the sample period, even after controlling for initial $CM(iT)$ means

Table 6. Mean in Non-Absolute Value Indicator of Currency Mismatch

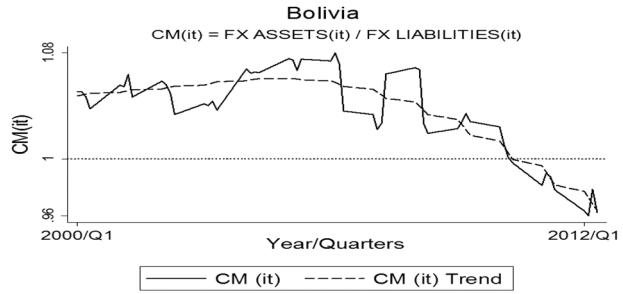
Country	$CM(iT)$*
Brazil	0.8523
Bolivia	1.0337
Uruguay	1.0437
Paraguay	1.0472
Peru	1.0519
Dominican Republic	1.0690
Honduras	1.0800
Chile	1.0934
Costa Rica	1.1077
Mexico	1.1107
Guatemala	1.1362
Argentina	1.2206
Colombia	1.2805
Aruba	1.2849
Eastern Carib. Countries	1.3037
Jamaica	1.3270
Nicaragua	1.3333

Sources: National authorities and author's calculations.
Notes: $^{*}CM(iT) = \sum_{t=0}^{t=T} CM(it)/T = \sum_{t=0}^{t=T} (FxAssets(it)/FxLiabilities(it))/T.$

(figure 2 shows that the rate of reduction is increasing in the initial mean, and the four countries appear below the regression line in this figure). Third, given that they have traditionally had a high level of financial dollarization, their central banks and financial supervisors implemented a significant number of policies aimed at reducing it.[17] Hence, it is natural to think that these policies can at least partially explain the joint observation of low $CMABS(iT)$ and $CM(iT)$, and the large reduction in these values. The next section shows that some of the prudential policies taken by Bolivia, Paraguay, and Peru did reduce the values of $CM(iT)$ and $CMABS(iT)$.

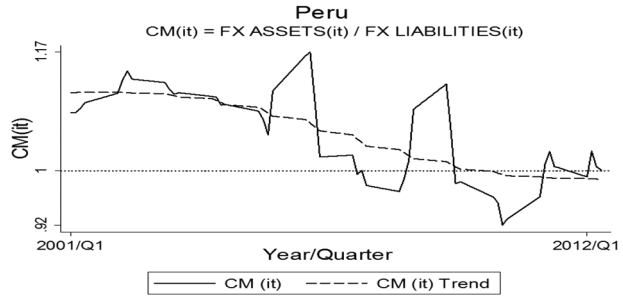
[17] See Tobal (2014) for a summary of the amount and types of prudential policies implemented from 1992 to 2012 and also Bailey (2005), Galindo and Leiderman (2005), Cayazzo et al. (2006), Leiderman, Parrado, and Maino (2006), Rennhack and Nozaki (2006), Sánchez (2006), León Rincón and Revéiz Herault (2008), Bacha, Holland, and Gonçalves (2009), and Tapia and Medinacelly (2015).

Figure 3. Time Behavior of $CM(it)$ and Its Trend: Bolivia



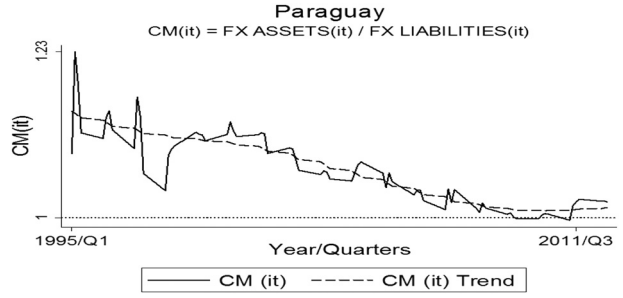
Sources: National authorities and author's calculations.
Notes: There is a decrease in trend since 2005. The minimum value of the trend is 2012:Q4.

Figure 4. Time Behavior of $CM(it)$ and Its Trend: Peru



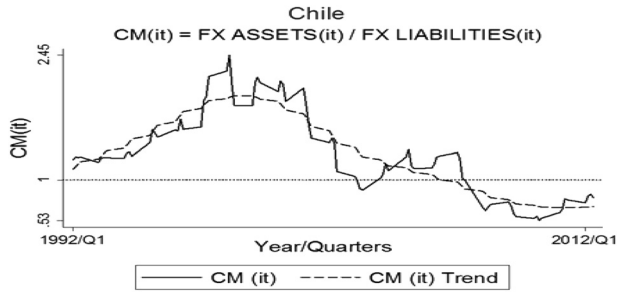
Sources: National authorities and author's calculations.
Notes: There is a decrease in trend since 2002. The minimum value of the trend is 2012:Q4.

Figure 5. Time Behavior of $CM(it)$ and Its Trend: Paraguay



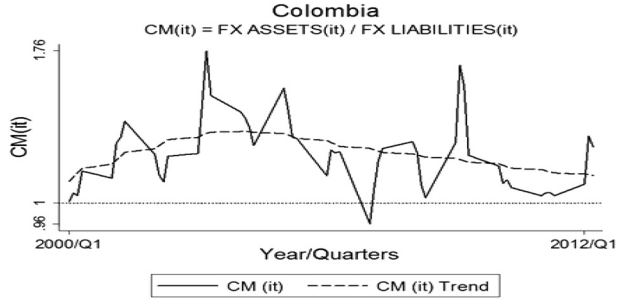
Sources: National authorities and author's calculations.
Notes: There is a decrease in the trend until 2011:Q3. The minimum value of the trend is 2011:Q3.

Figure 6. Time Behavior of $CM(it)$ and Its Trend: Chile



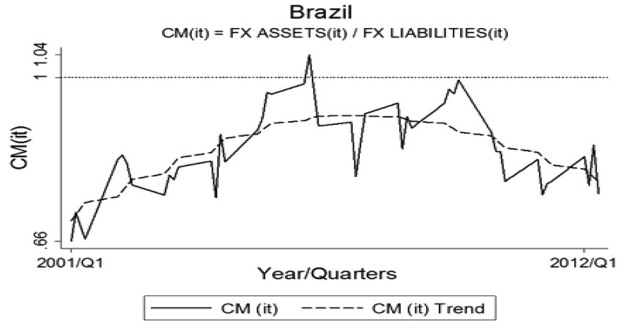
Sources: National authorities and author's calculations.
Notes: There is a decrease in the trend in 1999:Q1–2011:Q2. The minimum value of the trend is 2011:Q2.

Figure 7. Time Behavior of $CM(it)$ and Its Trend: Colombia



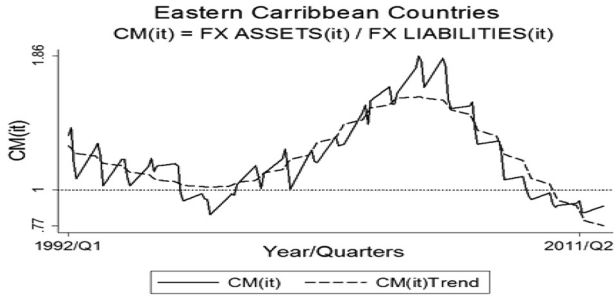
Sources: National authorities and author's calculations.
Notes: There is decrease in the trend since 2004:Q3. The minimum values of the trend are 2001 and 2012:Q4.

Figure 8. Time Behavior of $CM(it)$ and Its Trend: Brazil



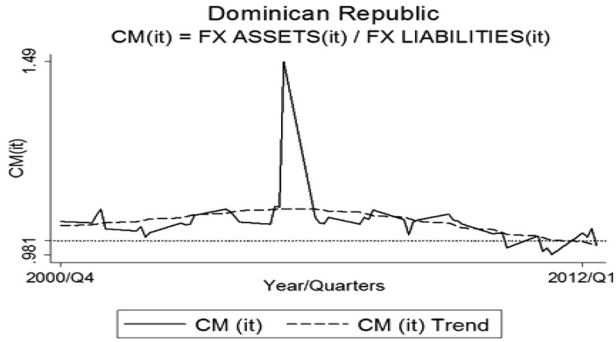
Sources: National authorities and author's calculations.
Notes: There is a decrease in the trend since 2007:Q3. The minimum values of the trend are 2001–02 and 2011:Q2.

Figure 9. Time Behavior of $CM(it)$ and Its Trend: Eastern Caribbean Countries



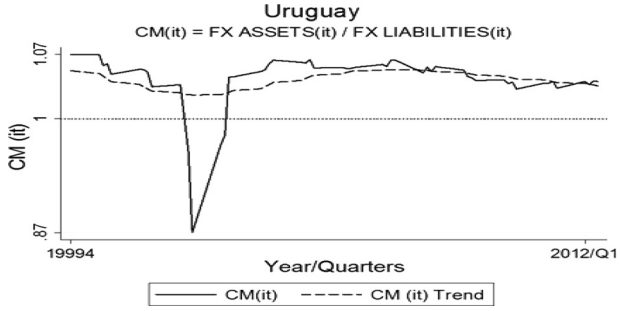
Sources: National authorities and author's calculations.
Notes: There is monotonic decrease in the trend since 2005:Q3. The minimum value of the trend is 2012:Q1.

Figure 10. Time Behavior of $CM(it)$ and Its Trend: Dominican Republic



Sources: National authorities and author's calculations.
Notes: There is a decrease in the trend since 2006:Q1. The minimum value of the trend is 2012:Q4.

Figure 11. Time Behavior of $CM(it)$ and Its Trend: Uruguay



Sources: National authorities and author's calculations.
Notes: There is a decrease in the trend since 2008:Q1. The minimum values of trend are 2001–03 and 2012:Q4.

5. Empirical Analysis

5.1 Analyzed Policies

This section evaluates the impacts of prudential policies on currency mismatches. The analysis focuses on limits on foreign currency positions (limits, hereafter). I concentrate on policies that are relevant for financially dollarized economies and, thus, define the treatment as a reduction in the limit on long positions (e.g., from 70 percent to 50 percent of banks' capital) and/or as an increase in the limit on short positions. I study whether these policies reduced $CM(it)$ (the outcome variable) and infer from the results whether they reduced the mean of $|CM(it) - 1|$

Bolivia, Peru, and Paraguay are the three economies that implemented these policies over 2000–12 and, therefore, the paper focuses on policies implemented in these countries. This is not surprising, given that these economies have been among the countries with the highest level of financial dollarization and, therefore, among the most proactive ones in changing limits on foreign currency positions (see Tobal 2014 for a reference on this point).

5.2 Methodology

The effect of a policy is the difference between the post-intervention outcome and the counterfactual, i.e., the outcome that would have

been observed in the absence of the intervention. However, when estimating policy effects, comparative case studies replace the counterfactual with the outcome trajectory of a control group. Nonetheless, this trajectory does not replicate the counterfactual properly in the presence of time-varying unobservable characteristics, as in the presence of these characteristics the outcome trajectory of the treated country and that of the control group differ, regardless of the effects of the policy.

This econometric concern is particularly relevant when studying prudential policies, because these measures are intrinsically associated with unobservable characteristics that vary over time. Take the case, for instance, of a country that implements a limit to reduce the growth of currency mismatches in its banking sector ("the treated country"). Notably, the fact that currency mismatches grow relatively fast in this country is likely to be driven by unobservable characteristics. The implication is that, even in the absence of intervention, its outcome trajectory would have been different from the outcome trajectory of other countries in which the policy was not implemented and that belong to the control group.

This fact poses a problem for difference-in-differences techniques, because these methodologies cannot control for time-varying unobservable characteristics and, consequently, yield to biased estimates of policy effects. Along these lines, the use of difference-in-differences techniques has raised important concerns about potential mis-estimates in the recent literature on FX regulation, but also in previous studies investigating the effects of capital account liberalization (see, for instance, Tamirisa 1999; Lim et al. 2011; Bonfiglioli 2005; Dell'Ariccia et al. 2012; and Ostry et al. 2012).

The synthetic control method (Abadie and Gardeazabal 2003 and Abadie, Diamond, and Hainmueller 2010) overcomes the abovementioned flaw in the difference-in-differences techniques. Particularly, it controls for unobservable characteristics that vary over time by constructing a synthetic unit and using it as counterfactual. The outcome trajectory of the synthetic unit results from assigning a weight, w_j, to the trajectory of each country within the control group. More importantly, the weights are chosen so that the synthetic unit most closely resembles the treated country in the pre-intervention period: the vector of weights W is chosen so as to minimize $(X_1 - X_0W)'V(X_1 - X_0W)$, where X_1 and X_0 and

contain pre-intervention values of outcome variable predictors for the treated and control countries, respectively, and V is a diagonal matrix that reflects their relative importance (see the appendix for a mathematical approach to the synthetic method using the data set in this study). Hence, when constructing the synthetic unit, the synthetic control method accounts for differences in outcome trajectories over the pre-intervention period and, therefore, for unobservable characteristics that vary over time.

5.3 Data Set Application

The analysis is carried out over a period of eleven quarters, centered at the period of the policy intervention, i.e., the limit changes in foreign currency position. This period is normalized at $t = 0$, so that the event window is written as $t \in [-5, 5]$.[18] In the manner of Abadie and Gardeazabal (2003), the outcome variable ($CM(it)$) is included in the matrices X_1 and X_0. In particular, the predictors' matrices consider three variables: $CM(it)$, the rate of change in the exchange rate, and the exchange rate itself, normalized by its mean value over the event window.[19] Given that the results are similar regardless of whether the latter two predictors are included, this section presents cases in which only $CM(it)$ is considered as a predictor.[20] For each policy intervention, the control group is defined as the set of countries that neither reduced the limit on long positions nor increased it on short positions during the event window.[21]

[18] Choosing a shorter event window would have left fewer pre-intervention periods to calculate the synthetic weights, while choosing a longer window would have reduced the number of policies available for study.

[19] The normalization of the exchange rate ensures that the values are comparable across countries.

[20] See appendix B in Abadie and Gardeazabal (2003) for a theoretical treatment on the case where the outcome variable is the only predictor. As for the V matrix, it is given by the default option in Stata. This option chooses V using a regression that finds the best-fitting W conditional on this regression.

[21] The synthetic method considers permanent differences in $CM(it)$ originating before the event window, because weights are chosen based on similarities with the treated country. Temporary effects of these policies, however, may alter the time behavior of $CM(it)$ only for a few periods and, thus, contaminate the choice of the synthetic weights. To tackle this issue, I define the control group as those countries that did not implement the policy during the entire event window.

To evaluate a policy, I study the difference between the outcome trajectory of the treated country and that of the synthetic unit after the intervention. However, this difference might be driven by events other than the policy, which occur either at the intervention quarter or during the post-intervention period (the synthetic method accounts for events or policies that occur before the intervention). I follow three strategies to tackle this issue. First, I study differences between average trajectories by taking the mean of $CM(it)$ across (i) treated countries and (ii) their synthetic units. The difference between these average trajectories should be less affected by specific events, because the means are taken over policies implemented by different countries and at different moments in time. Second, I calculate the averages with and without considering Peru; this strategy is relevant because this country experienced several policies of the same type within the same event window. Third, only countries that neither increased the limit on long positions nor reduced the one on short positions during the event window are considered.[22]

5.4 Case Studies: Results

This section analyzes policies implemented in the three countries mentioned above: Bolivia, Peru, and Paraguay. Bolivia has now been long considered a financially dollarized economy and has, thus, a long tradition of implementing policies attempting to regulate long foreign currency positions.[23] According to research by officials from the Central Bank of Bolivia, financial dollarization mainly imposes three challenges on their economy (Tapia and Medinacelly 2015): (i) it reduces the power of the central bank to act as a lender of last resort, triggering risks for financial stability; (ii) it clearly diminishes the effectiveness of the monetary policy transmission mechanism by reducing the impacts of changes in domestic money aggregates

[22]This requirement only excludes the policies implemented by Honduras.

[23]In November 1982, the Bolivian government implemented a series of policy measures to force de-dollarization and then, after a rapid increase in the 1990s, combined changes in reserve requirements, limits on foreign currency positions, and exchange rate regimes to reduce the degree of financial dollarization.

and domestic interest rates on borrowing and lending; and (iii) it is associated with large currency mismatches and, therefore, with significant amounts of foreign currency risk.

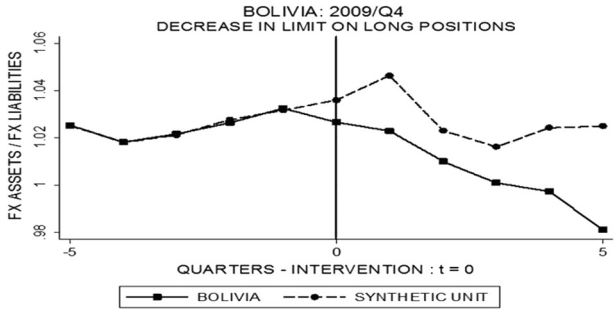
Among the prudential policies taken by Bolivia, this subsection focuses on the measure implemented in 2009, when in December the limit on long foreign currency positions for banks in Bolivia fell from 70 percent of their accounting patrimony to 60 percent of the same base. The policy seems to have sought to further promote the remonetizing process of the Bolivian economy, understood as a process through which households and banking institutions would substitute U.S. dollars with bolivianos in saving, borrowing, and lending (this process is frequently referred to in Bolivia as "Bolivianización").

Figure 12 shows the behavior of $CM(it)$ during the event window; the solid and the dashed curves depict the trajectories for Bolivia and for the synthetic unit, respectively. The trajectories are close to each other during the pre-intervention period, indicating that the synthetic weights provide a good fit. The reduction of the limit reduced $CM(it)$ by 0.9 percent over the five quarters after the intervention. More importantly, the policy reduced long foreign currency positions: the currency mismatch indicator was lower for Bolivia than it was for the synthetic unit in every quarter of the post-intervention period. Precisely, $CM(it)$ was, on average, 2.45 percent lower for Bolivia. The intervention also reduced the average currency mismatch: whereas the mean of $|CM(it) - 1|$ over the post-intervention period equaled 0.011 for Bolivia, it equaled 0.027 for the synthetic unit.

The possibility that the exchange rate adjusts abruptly has also been a significant source of financial risks in Peru, making this country one the most proactive Latin American economies in changing its limits on foreign currency positions over the last two decades (Tobal 2014).[24] One of the earliest changes undertaken by Peru dates back to 1992, when the financial regulator ("Superintendencia de Banca, Seguros y Administradoras Privadas de Fondos de Pensiones") established a limit on commercial banks' short open foreign

[24]Indeed, the policies implemented in Peru have been significantly spread over time, suggesting that foreign currency risk has been a more frequent source of concern in this country.

Figure 12. Policy in Bolivia



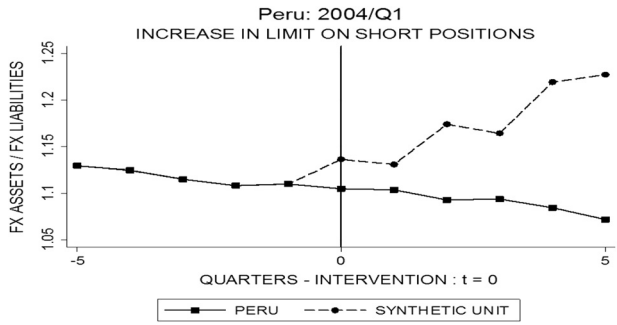
Sources: National authorities and author's calculations.

exchange position of 2.5 percent of their capital. Research by officials from this institution suggests that the goal of this prudential policy was to avoid the contemporary depreciating trend of the sol damaging banks' capital (Canta, Collazos, and Shiva 2007).

Nonetheless, by the end of 2003, the trend of the sol reversed. In this context, the emergence of new economic conditions induced the financial regulator to relax the policy undertaken in 1992. In particular, the limit on commercial banks' short open foreign exchange position increased, going from 2.5 percent of banks' capital to 5 percent of the same base in 2004. In this framework, it was desirable to reduce exposure to foreign currency risk for banking institutions and to diminish the volatility of the exchange rate.

Figure 13 shows the trajectories of $CM(it)$ associated with the intervention. The trajectories for Peru and for the synthetic unit are similar during the pre-intervention period, signaling a good fit of the synthetic weights. Note in this figure that $CM(it)$ did not decrease by a significant amount after the intervention: the average rate of decrease over the five quarters equaled 0.6 percent. However, the comparison with the counterfactual shows that the policy reduced long positions: the value of $CM(it)$ was lower for Peru in every quarter of the post-intervention period. Specifically, $CM(it)$ was on average 8.2 percent smaller for Peru than for the synthetic unit. Along the same lines, the average of $|CM(it) - 1|$ over the five quarters after the intervention equaled 0.09 for Peru and 0.18 for the synthetic unit.

Figure 13. Policy in Peru



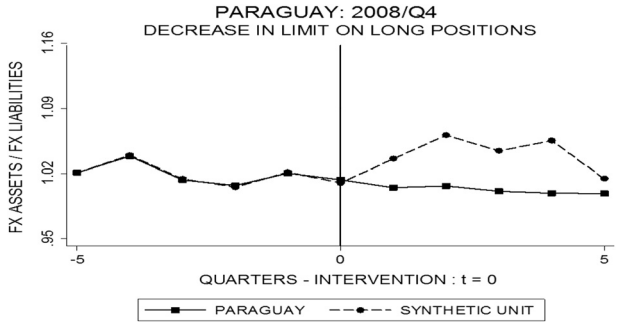
Sources: National authorities and author's calculations.

Paraguay has a long tradition of financial dollarization as well. Just as in Bolivia, the public's willingness to hold U.S. dollars, and thus financial dollarization, deepened in the 1990s as a result of a severe crisis that reduced confidence in the guarani (García-Escribano and Sosa 2011). Accordingly, this country changed its limits on foreign currency positions multiple times from 1992 to 2012 (Tobal, forthcoming).

One of these policies refers to the change in the limit on long foreign currency positions applied in 2008. In October of that year, the Central Bank of Paraguay reduced this limit, taking it from 50 percent to 30 percent of banks' accounting patrimony. According to officials from this central bank, the implementation of this prudential policy mainly had three goals: (i) diminish volatility in the exchange rate, similar to the changes undertaken from 1992 to 2012; (ii) reduce exposure to foreign currency risk by diminishing currency mismatches; and (iii) reduce potential mismatches of maturity in foreign currency positions.

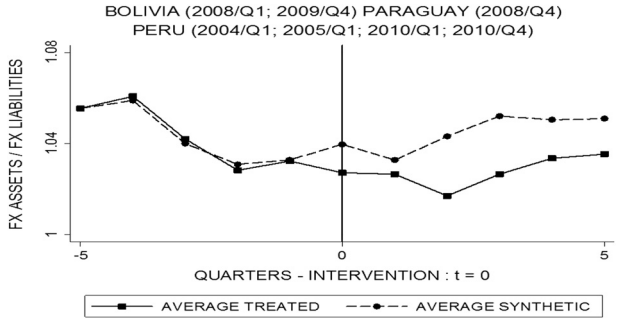
Figure 14 analyzes the intervention and shows that the fit of the synthetic weights is almost perfect during the pre-intervention period. The $CM(it)$ indicator decreased by 0.29 percent on average over the post-intervention period. This indicator was lower for Paraguay in every quarter after the intervention, with an average difference of 3.92 percent with respect to the synthetic unit. Paraguay also performed better than the counterfactual in terms of average mismatches: whereas the mean of $|CM(it) - 1|$ equaled 0.003 for the former, it was equal to 0.042 for the latter.

Figure 14. Policy in Paraguay



Sources: National authorities and author's calculations.

Figure 15. Averages for Policies in the Treatment



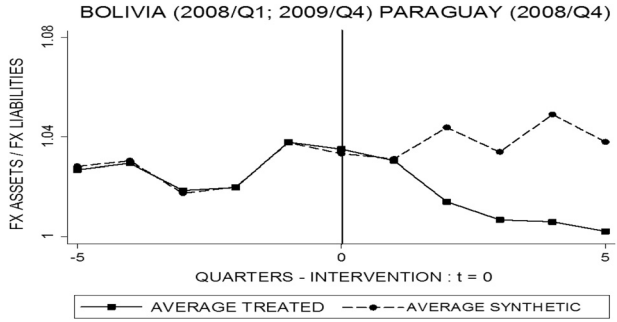
Sources: National authorities and author's calculations.

5.5 Robustness Checks: Average Trajectories

To check the robustness of the results presented in the previous subsection, I first calculate means across all prudential policies considered in the treatment group. That is, I average the outcome trajectories associated with the policies implemented in Bolivia (first quarter of 2008 and fourth quarter of 2009), Paraguay (October 2008), and Peru (first quarter of 2004, first quarter of 2005, and first and fourth quarters of 2010).

The solid curve in figure 15 shows the average trajectory for the treated countries, and the dashed curve shows the average trajectory for their synthetic units. Note that, on average, the policies

Figure 16. Averages for Policies, Excluding Peru



Sources: National authorities and author's calculations.

considered in the treatment group reduced currency mismatches; the average $CM(it)$ was lower for the treated countries than it was for the synthetic units, with a mean difference of 1.74 percent over the post-intervention period. The policies also reduced the average currency mismatch: the mean of $|CM(it) - 1|$ for the synthetic units was greater than for the treated countries (0.46 for the former and 0.28 for the latter).

A concern about the average trajectories shown in figure 15 is the inclusion of the four policies implemented by Peru. Peru changed the limit on foreign currency positions twice (the intervention under study plus an additional change) within every one of the four event windows. In this context, it may be argued that the difference between the post-intervention trajectories is not driven by the intervention under study (implemented at the intervention quarter). Therefore, to tackle this issue, I recalculate the average outcome trajectories shown in figure 15, excluding the four policies implemented by Peru.

Figure 16 shows the new average trajectories. The policies implemented reduced on average long foreign currency positions: the average of $CM(it)$ was lower for the treated countries than for the synthetic units in every quarter after the intervention; the mean difference between the averages equaled 2.66 percent over the post-intervention period. The mean of $|CM(it) - 1|$ was 0.12 for the treated countries and equaled 0.39 for the synthetic units: the policies also reduced the average level of currency mismatch.

6. Conclusions

In this paper, I have collected data on assets and liabilities in the banking sector of a highly dollarized region, Latin America and the Caribbean. These data have allowed me to construct measures of currency mismatch that circumvent the issues of existing indicators—in particular, the indicators that are based on sectoral-level information and data disaggregated by currency of denomination.

Employing the novel data set, I have shown the existence of new facts. The trend in foreign currency positions broke after 2007 in several banking sectors, which is consistent with a generalized reduction in long foreign currency positions and the emergence of short positions in the second half of the 2000s. I claim that these facts can be partially explained by the de-dollarization policies implemented in the region. Employing a methodology never used to this end, I have evaluated some of these policies in three highly dollarized countries—Bolivia, Paraguay, and Peru—and shown that these policies were successful in reducing long positions and the average level of currency mismatch.

Appendix. Description of the Survey

Section 1 of the survey deals with policies that regulate or give banks incentives to change their foreign currency position, such as reserves and capital requirements associated with these positions. Section 2 covers regulatory policies based on the residence principle, such as taxes, reserve requirements, and limits to external assets and liabilities or capital flows. Section 3 discusses FX interventions. Finally, section 4 studies the same instruments as section 1 but applied to credits and deposits. Each section focuses on three dimensions: they tracked all of the changes in implementing prudential instruments from the beginning to the end of the sample period (June 1992–June 2012), implementation characteristics (e.g., the characteristics of implementation (e.g., "limits established over banks' capital"), and the goals of the implementation. The survey has been reproduced on the following pages.

Financial Stability and External Imbalances Survey

General Considerations

Section Topics

- Section 1: Instruments that Limit Foreign Currency (FX) Positions or Create Incentives that Deter FX Positions
- Section 2: Instruments that Impact Capital Flows or that Create Incentives for Behavior that Impacts Capital Flows
- Section 3: Interventions in the Foreign Currency Market
- Section 4: Instruments that Limit Foreign Currency (FX) Credit or Create Incentives that Deter FX Credit
- Section 5: Financial Variables

Sample Specifications

Please provide information about the instruments that were being used on June 1, 1992 and about all the policies changes dealing with these instruments within the period specified for each section (see table below).

Note: The period specified for Section 5 begins at the earliest date for which your data is available.

Period of interest for each section (DD/MM/YYYY)

Section 1		Section 2	
Period begins: 1-6-1992	Period ends: 1-6-2012	Period begins: 1-6-1992	Period ends: 1-6-2012
Section 4		Section 4	
Period begins: 1-6-1992	Period ends: 1-6-2012	Sample begins: 1-6-1992	Period ends: 1-6-2012
Section 5			
Period begins: earliest date for which data is available	Period ends: 1-6-2012		

Instructions Specific to Sections 1 to 4

Column Labeled "Authorities"

In the tables that appear in Sections 1, 2, and 4 you will find a column labeled "Authorities." Please indicate which institution(s) was involved in the policy decision and its implementation.

Column Labeled "Level-Feature"

In the tables that appear in sections 1, 2, and 4 you will find a column labeled "Level-Feature." Please provide information about the level at which the instrument was established and the features of the policy under this column. For instance, in Section 4 for the instrument "limit on FX credit," you should write: "Established as a percentage over tier 1 capital, applied only to short-term lending" (features of the policy) and "at 15% level" (level at which the instrument was established).

Note: It is important that you provide information about the level and the features of the instruments that were being used on June 1, 1992 and information about all the policies changes dealing with these instruments within the period specified for each section.

Columns Labeled "Goal Weight"

In the tables that appear in Sections 1–4 you will find columns labeled "Goal Weight" that are enumerated. Above each table, you will find a chart with a list of goals that you may have pursued in the appliance of the policies. You should match an enumerated column from the table with a goal from the chart by using the number assigned to it. Determine a weight between 0 and 1 for each goal based on its relevance in the appliance of the policy. Provide also a brief explanation for each goal to which you assign a weight greater than 0 in the same cell where you specify the weight (e.g., *Weight to Goal 1 from Section 1—controlling credit growth—: 0.5; Brief Explanation: the credit growth rate was "higher" than desired).*

The sum of the weights assigned to the goals that appear in every list must be equal to 1. See the following example for Section 4:

LIST OF GOALS FOR SECTION 4
1. Reducing the volatility of the credit cycle
2. Achieving exchange rate stability
3. Reducing loans to borrowers un-hedged from exchange rate variations
4. Correcting current account imbalances
5. Other: please explain briefly

	Commence-End Dates	Level-Feature	Autho-rity	Goal Weight					
				1	2	3	4	5	Total Weight
Instrument	**Limit on FX credit**								
Initial	01/06/1992–01/06/1993	Established as a percentage over tier 1 capital, applied only to short-term lending. At 15% level.	Central Bank	0	0.5. Explanation—Residents were borrowing in dollars and selling dollars leading to depreciations of the national currency.	0.5. Explanation—Residents were largely indebted in US dollars and we had no information on how hedged they were from exchange variations.	0	0	1

Instructions Specific to Section 5

In Section 5, provide information about foreign exchange liabilities and foreign exchange assets. The data will be used to construct a comprehensive database that will be available only to the cooperating central banks' members.

Information Disaggregation

We ask you to please provide information on variables referring to two sectors: the banking sector and the non-banking sector (excluding government). We provide one table listing the variables we think you may have available for the banking sector and another table for the non-banking sector. We will highly appreciate that you provide information of the available variables by quarter frequency (e.g., 2005:Q1, 2005:Q2,. . . ,2012:Q2). However, if the data is not available by quarter, then please provide the highest time-frequency that is available.

Data Availability

Being aware that the information we are requiring is scarce for the 1990s, we have established the beginning of the period of interest as the "earliest date for which your data is available." We are also aware that you may not have available information for filling all the blanks that appear in the tables for every quarter. We ask you to please fill as many blanks as possible and provide information on as many quarters as you can.

1. Instruments That Limit Foreign Currency (FX) Positions or Create Incentives That Deter Them

Please consider the use of any instruments that limit foreign currency (FX) positions or create incentives for deterring these positions.

Consider the following example regarding the column "Level-Feature:" "*Limit on Bank's gross positions (liabilities, not assets), spot market, 10% of working capital.*"

Please remember to provide a *brief explanation* for each goal to which you assign a weight greater than 1. Please consider the instruments that were being used on June 1, 1992 (Initial: 01/06/1992) and all the policies changes dealing with these instruments within the period specified (CHANGE 1, and so on).

LIST OF GOALS FOR SECTION 1
1. Controlling credit growth 2. Achieving exchange rate stability 3. Reducing currency mismatches 4. Reducing maturity mismatches of foreign currency positions 5. Correcting current account imbalances 6. Other: please explain briefly

	Commence-End Dates	Level-Feature	Authority	Goal Weight						
				1	2	3	4	5	6	Total
Instrument	**Limits to foreign currency positions in the spot market**									
Initial	01/06/1992-									0
Change 1										0
Change 2										0
Change 3										0
Instrument	**Limits to foreign currency positions in the derivatives market**									
Initial	01/06/1992-									0
Change 1										0
Change 2										0
Change 3										0
Instrument	**Provisioning requirements specific to foreign currency positions**									
Initial	01/06/1992-									0
Change 1										0
Change 2										0
Change 3										0
Instrument	**Other uses of instruments that limit foreign currency (FX) positions or create incentives that deter these positions** (e.g., lower remuneration for reserves on foreign exchange positions)									
Instrument 1	01/06/1992-									0
Change 1										0
Change 2										0
Change 3										0
Change 4										0
Change 5										0
Instrument 2	01/06/1992-									0
Change 1										0
Change 2										0
Change 3										0
	Other changes in the instruments that either we or yourself have mentioned above									
Change 1										0
Change 2										0
Change 3										0

2. Instruments That Impact Capital Flows or Create Incentives for Behavior That Impacts Flows

Please consider the use of any instruments that impact capital flows or that creates incentives for behavior that impacts capital flows.

Consider the example regarding the column "Level-Feature": reserve required on bank deposits from non-residents, 10% higher than reserves required on bank deposits for residents.

Please remember to give a *brief explanation* for each goal with a weight greater than 1, and to consider both the beginning of the sample period (Initial: 01/06/1992) and subsequent policies with the instrument (CHANGE 1, and so on).

LIST OF GOALS FOR SECTION 2

1. Managing capital flows to control credit growth
2. Achieving exchange rate stability
3. Tilting the composition of inflows towards longer maturity
4. Correcting current account imbalances
5. Other: please explain briefly

	Commence-End Dates	Level-Feature	Authority	Goal Weight					
				1	2	3	4	5	Total
Instrument	**Taxes on capital outflows or taxes on capital inflows (Please specify inflows or outflows)**								
Initial	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument	**Additional reserve requirements imposed to capital outflows or imposed to capital inflows (Please specify inflows or outflows)**								
Initial	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument	**Limits to foreign investment by domestic pension funds**								
Initial	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument	**Minimum holding periods for inflows**								
Initial	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
	Other uses of instruments that impact capital flows or create incentives for behavior that impacts capital flows								
Instrument 1	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument 2	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument 3	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument 4	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument 5	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
	Other changes in the instruments that either we or yourself have mentioned above								
Change 1									0

3. Interventions in Exchange Rate Market

Please assign weights to the goals, and identify an exchange rate regime and a type of intervention. You will find the list of goals, the exchange rate regimes, and the types of interventions in the following table.

LIST OF GOALS FOR SECTION 3

1. Achieving exchange rate stability to avoid sudden stops.
2. Achieving exchange rate stability for reasons other than 1, 3, or 4
3. Achieving exchange rate stability to reduce the impact of its variations on financial wealth
4. Changing exchange rate to correct current account imbalances
5. Other: please explain briefly

FX REGIMES

1. Fixed exchange rate
2. Float exchange rate
3. Pegged float
4. Target zone exchange rate
5. Dollarization

TYPE OF INTERVENTION

1. Follow a pre-established rule*
2. Discretional interventions

*Did the intervention follow a rule for interventions to which the central bank had committed

Date		Number of Operations	Exchange Rate Regime	Type of Intervention	Goal Weight					
					1	2	3	4	5	Total
1992	Q1									0
	Q2									0
	Q3									0
	Q4									0
–	Q1									0
	Q2									0
	Q3									0
	Q4									0
2012	Q1									0
	Q2									0

4. Instruments That Limit Foreign Currency Exchange (FX) Credit or Create Incentives That Deter FX Credit

This section concerns economies that allow financial institutions to extend loans in foreign currency to residents. Please consider the use of any instruments that limit foreign currency credit or aim at deterring this credit. Consider the following example regarding the column "Level-Feature:" limit on FX credit, established as % over tier 1 capital, applied only to short-term lending.

Please remember to provide a brief explanation for each goal with a weight greater than 1, and to consider both the beginning of the sample period (01/06/1992) and subsequent policies dealing with the instrument (CHANGE 1, and so on).

LIST OF GOALS FOR SECTION 4
1. Reducing the volatility of the credit cycle
2. Achieving exchange rate stability
3. Reducing loans to borrowers un-hedged from exchange rate variations
4. Correcting current account imbalances
5. Other: please explain briefly

	Commence-End Dates	Level-Feature	Authority	Goal Weight					
				1	2	3	4	5	Total Weight
Instrument	**Limit on FX credit**								
Initial	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument	**Additional capital requirements for foreign currency lending**								
Initial	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument	**Additional risk-weight for loans extended in foreign currency**								
Initial	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Change 4									0
Change 5									0
Instrument	**Additional provisioning requirements for loans extended in foreign currency**								
Initial	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument	**Other uses of instruments that limit foreign currency credit or aim at deterring this credit** (e.g., difference between the remuneration on reserves imposed to inflows and the remuneration on reserves)								
Instrument 1	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument 2	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
Instrument 3	01/06/1992-								0
Change 1									0
Change 2									0
Change 3									0
	Other changes in the instruments that either we or yourself have mentioned above								
Change 1									0
Change 2									0
Change 3									0

5. Financial Variables

In this section we ask you to provide information about foreign currency liabilities and foreign currency assets, for the banking sector (excluding government). Our goal is to construct indicators of financial exposure to foreign currency variations. We will highly appreciate that you provide information of the available variables by quarter frequency (e.g., 2005:Q1,. . . ,2012:Q2). We are also aware that you may not have data to fill all the blanks that appear in the tables for every quarter and ask you to please fill as many blanks as you can. Please provide information from the earliest date for which your data is available.

BANKING SECTOR	
Banks' Foreign Currency Assets Position (U.S. Dollars)	**Banks' Foreign Currency Liabilities Position (U.S. Dollars)**
Foreign Currency Bank Assets Total	Foreign Currency Bank Liabilities Total
Portfolio Investment	Portfolio Liabilities
Equity	Equity
Debt Instruments	Debt Instruments
Short Term	Short Term
Long Term	Long Term
Derivatives	Derivatives
Other Investment	Other Liabilities
Trade Credits	Trade Credits
Loans	Loans
Short-Term Total	Short Term
Short Term to Residents	
Long Term	Long Term
Short Term to Residents	
Money and Deposits	Money and Deposit
Short Term	Short Term
Long Term	Long Term
Other Investment Asset	Other Liabilities

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