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THE BANK LENDING CHANNEL IN A PARTIALLY DOLLARIZED ECONOMY

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This paper studies the transmission of monetary policy through the bank-lending channel in a partially dollarized banking system. Taking advantage of the cross-sectional and time-series variation in individual Mexican bank balance sheets, I find that the deposits and loans of banks that have a larger share of foreign currency deposits are less sensitive to domestic monetary shocks, particularly for small banks. The results also suggest that banks with a larger foreign deposit share are more sensitive to foreign (U.S.) monetary shocks and Mexican country risk. The results indicate a novel way in which monetary policy has real effects in a partially dollarized economy: Not only are banks unable to easily replace insured deposits with other sources of funds because of information frictions (the conventional bank lending channel), but they are also unable to fully offset a loss of domestic currency deposits with foreign currency deposits.

JEL classification codes: E5, F31, G21
Key words: monetary policy, bank lending channel, dollarization

I. Introduction

The purpose of this paper is to understand how the bank lending channel of monetary policy transmission is affected by the dollarization of the banking sector. Debate continues on the mechanism of monetary transmission for single-currency economies. A study in a partially dollarized setting contributes to this

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wider debate by looking at one channel of monetary policy that is not present in a single-currency setting. This channel links bank lending with the currency composition of a key component of bank liabilities, namely deposits. In particular, I motivate and empirically test the mechanism by which banks, varying in their initial share of foreign currency deposits, respond differently to the same monetary policy shock. This response is not limited to changing the currency composition of bank liabilities or to altering more generally the make-up of these liabilities. The constraints binding on the liability side affect the asset side if bank assets are not decoupled from bank financing, which will be true in the presence of capital market frictions and restrictions. This generates economically interesting and potentially important effects of monetary policy on loanable funds, credit, and therefore on real activity in a partially dollarized economy.

To understand the bank lending channel in a partially dollarized economy, I first motivate the basic bank lending channel of monetary policy transmission. The bank lending channel is one mechanism that amplifies the transmission of monetary policy because of credit market frictions such as asymmetric information. In the absence of such frictions, monetary policy operates through the conventional interest rate channel.[1] The extent to which monetary policy can influence short-term real interest rates (because prices are sticky) alters the real cost of capital for firms and thus investment. This conventional interest rate channel is magnified and propagated by frictions that are collectively known as the "credit channel of monetary policy transmission" (Bernanke and Gertler 1995 provide an excellent summary). Information frictions in credit markets create a gap between a borrower's internal funds (retained earnings) and more costly sources of external finance. Monetary policy endogenously influences the borrower's external finance premium because of two amplifying mechanisms: the "balance sheet channel" affecting the borrower's net worth and the "bank lending channel" influencing the supply of loans by depository institutions. For example, a monetary policy tightening will negatively impact the borrower's net worth, raising the borrower's external finance premium and reducing its credit demand.[2]

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[1] I abstract from non-traditional monetary policy actions such as large-scale asset purchases and emergency liquidity provision to the financial system that occurred in the recent global financial crisis. I also abstract from monetary policy actions aimed at actively changing reserve requirements. In general, countries do not use legal requirements as a policy tool. This study also examines Mexico, which has no legal reserve requirement.

[2] An increase in the interest rate reduces the borrower's net worth in a number of ways: Higher interest rates increase interest payments on the firm's outstanding debt. Likewise, contractionary monetary policy reduces asset values such as property, decreasing a firm's collateral, leading to a collateral squeeze.

I focus on the second amplifying mechanism of monetary policy — the bank lending channel — developed by Bernanke and Blinder (1988, 1992). Just as non-financial firms cannot frictionlessly raise external funds, so too banks face capital market imperfections. Because of agency costs, banks cannot perfectly and quickly undo a loss in insured deposits by raising other uninsured liabilities, such as CDs, subordinated debt and equity. Thus, the Modigliani-Miller theorem does not hold and the composition of a bank's liabilities will not be decoupled from its asset portfolio. In fact, agency costs may be more severe for banks because their assets are opaque and harder to value than those of non-financial firms. When the central bank conducts contractionary monetary policy, reducing reserves and hence deposits, loan supplies will be cut. This inward shift in the bank lending schedule raises the cost of loans on top of the interest rate rise on bonds due to the monetary contraction. That bank loans will be restricted and their cost increased will also increase the external finance premium of borrowers. Bank-dependent borrowers will face disruptions in credit because they cannot perfectly access other sources of external funds from other lenders and capital markets.

When the banking system is partially dollarized, additional frictions impede the ability of banks to replace domestic currency deposits. Suppose that there is a shock (without yet specifying whether this shock is a monetary policy one) that leads to an inward shift in households' demand for domestic currency deposits as households rebalance their asset portfolio. In addition to non-deposit liabilities, a new source of funds available to banks is a foreign currency deposit. However, some banks will be better able to replace domestic with foreign currency deposits because banks differ in their intermediation costs of foreign exchange. Differences can arise from regulation, geography, as well as technological differences between banks. Therefore, the Modigliani-Miller theorem may also not hold for deposits in the context of dollarization. This failure gives rise to a new currency-sensitive lending channel of monetary policy, overlooked in the prior literature. This lending channel depends on the initial currency composition of a bank's deposits.

I link monetary policy directly to the shock leading to a shift in the demand for domestic currency deposits. Banks that start out with a larger share of foreign currency deposits will be less sensitive to domestic monetary policy shocks. For example, a contractionary shock will lead to a decline in deposits but *less* so for banks with more foreign currency deposits. There are two reasons. First, households are more likely to substitute away from domestic currency deposits into domestic bonds than from foreign currency deposits into domestic bonds when the domestic interest rate increases. Foreign currency deposits provide households with a hedge

against exchange rate risk, which cannot be done by holding domestic bonds. Second, an unanticipated monetary tightening implies an expected depreciation of the domestic currency over the future horizon, assuming that uncovered interest rate parity holds between domestic and foreign currency bonds. This provides an additional incentive for depositors to shift away from domestic currency deposits.[3] Therefore, monetary policy-induced shifts in deposits expose those banks that are more reliant on domestic currency deposits. Together with frictions that hamper banks from perfectly offsetting domestic currency deposit changes with non-deposit funds and foreign currency deposits, this means that loan supplies of banks reliant on domestic currency deposits will be most affected.

It is important to assess the importance of a currency-sensitive bank lending channel given the widespread presence of banking systems with substantial assets and liabilities in foreign currency (e.g., Baliño et al. 1999; De Nicolo et al. 2005). For example, the share of dollar deposits in South America increased from 46% to 56% from 1996 to 2001 (De Nicolo et al. 2005). This paper follows Kashyap and Stein's (2000) use of individual bank data to empirically identify the bank lending channel in a partially dollarized banking system.[4] Drawing on an unbalanced monthly panel of 56 Mexican banks from 1995 to 2002, the results support the existence of a lending channel in Mexico dependent on the currency composition of bank deposits. The deposits and lending of banks with more foreign currency deposits as a share of their total deposits are less sensitive to domestic monetary shocks, and in particular those of small banks. Because the domestic interest rate, which is used to capture domestic monetary policy shocks, may be contaminated with foreign monetary shocks and country risk shocks (the latter is proxied by the spread on Mexico's Brady bond, a highly liquid dollar-denominated bond),

[3] Uncovered interest parity states that interest differentials must be equal to the expected currency depreciation, in order to equalize the returns on the two bonds. This ensures that risk-neutral and rational investors are indifferent between holding both bonds in equilibrium. An unanticipated monetary tightening leads to an increase in the domestic interest rate and therefore to the interest differential, all else fixed. The depreciation of the domestic currency expected over the future horizon must then rise by the amount of the differential to restore equilibrium. Note that for this second effect to work, uncovered interest parity holds between domestic and foreign currency bonds, but not between domestic and foreign currency deposits. This is a reasonable assumption, commonly assumed in models such as the money-in-utility function approach, which I lay out in the separate online appendix. Deposits are held for liquidity purposes and earn zero or little interest. Supporting evidence is in Section III.

[4] Kashyap and Stein's key innovation was the use of bank-level data, while previous empirical evidence relied on aggregate bank credit time series (e.g., Bernanke and Blinder, 1992). However, a limitation to aggregate data is the identification problem — the difficulty of separating loan supply effects (the lending channel) from confounding loan demand effects.

I also include these shocks. Predictions can also be made on the sensitivity of deposits and loans to these shocks. Just as banks with a larger share of foreign currency deposits are less sensitive to domestic monetary policy shocks, they should be more sensitive to foreign (U.S.) interest rate shocks. The empirical evidence generally lends support to this prediction. Banks with a larger share of foreign currency deposits are also more sensitive to country risk. That is, they are more prone to lose deposits and cut back lending when Brady bond spreads increase (and with that, fears of a forced conversion). Finally, I carry out robustness tests and rule out alternative channels, which compete with the lending channel. These include the firm balance sheet channel, which relies on heterogeneity in the demand for credit by firms.

This paper is related to a number of papers uncovering a bank lending channel starting with Kashyap and Stein (2000) who showed that lending by liquid banks is less responsive to monetary policy because these banks can run down their buffer of liquid assets to support lending when external funding is tight. Kashyap and Stein also showed that, in practice, the lending channel is active among small banks, while large banks have easy access to outside funds that substitute for a shortfall in insured deposits (see also Jayaratne and Morgan 2000; Kishan and Opiela 2000; Vazquez 2003, among others, for similar evidence). Other papers have applied a VAR approach on aggregate data following Bernanke and Blinder (1992), also finding support for a lending channel (e.g., see Copelman and Werner 1995, and Hernandez 2001, for evidence from Mexico). One interesting paper by Cetorelli and Goldberg (2012) compares the response to domestic monetary shocks of banks with global operations to those without global networks. While the comparison in Kashyap and Stein is between small and large banks, the comparison in the latter paper is between large global banks and large non-global banks. They find that global banks are able to mitigate the effect of domestic liquidity shocks because they manage liquidity using cross-border internal funding markets.

However, despite the proliferation of papers looking at advanced and emerging market economies, it remains unaddressed what currency-sensitive departure the bank lending channel takes in a partially dollarized setting. It is to this end that my paper contributes novel evidence. That is, this paper quantifies how the bank lending

channel works through the currency composition of bank deposits.[5] Allowing me to disentangle the effect of domestic monetary shocks from external monetary shocks is the fact that monetary policy in Mexico during the period of analysis was not highly correlated with external (U.S.) monetary policy. In addition, there is considerable variation in foreign currency deposits across Mexican banks, driven largely by exogenous geographic and regulatory differences.

The remainder of this paper is organized as follows. Section II begins by describing Mexican credit conditions and monetary policy. Section III develops a framework for the empirical estimation and provides a rationale for the hypotheses. This section also describes the bank balance sheet data and the variation in key bank characteristics. Section IV presents the main results and Section V concludes.

II. Empirical framework

A. Credit conditions in Mexico

Banks are an important source of credit for firms in emerging market economies, including Mexico. The lending channel is, therefore, expected to be more effective than in the U.S., where capital market innovations over the past decades have weakened its transmission (e.g., Carpenter and Demiralp 2012 find no bank lending channel in the U.S. since the 1990s). Agency costs are greater in developing economies, hindering the ability of banks to raise external finance. Imperfect substitution between sources of funds is also more severe in emerging economies because of the more systemic nature of shocks.

The Mexican case is an informative one for studying the lending channel in a partially dollarized setting. First, detailed monthly bank data are available with a lot of cross-sectional heterogeneity in foreign currency deposits needed for the identification. Second, more importantly, the Mexican economy was relatively

[5] A more developed (yet still inconclusive) literature exists on the effect of monetary policy on the balance sheet of firms through their foreign currency debt. For example, Chang and Velasco (2001) show that liability dollarization does not dominate the benefits of a conventional countercyclical monetary policy. In contrast, Aghion et al. (2000) argue that it is optimal to have procyclical monetary policy in some cases. Empirically, Aguiar (2005) finds that a devaluation has an adverse effect on the investment of exporting firms, while Bleakley and Cowan (2008) show that the competitiveness effect outweighs the negative balance sheet effect. In another strand of this literature, Ber et al. (2002) and Tornell and Westermann (2002) find that firms in the tradable sector are less affected by increases in the domestic lending rate because they can borrow at the international rate.

stable over the sample period from 1995 to 2002, with an independent monetary policy but a history and geography that led to a partially dollarized banking sector. Many other dollarized economies suffer from an unstable economic setting with high and volatile inflation and exchange rate shocks, which makes it difficult to identify the channels of monetary policy — alternatively, monetary policy in partially dollarized economies is often perfectly synchronized with foreign (U.S.) monetary policy, also making it difficult to disentangle the domestic and foreign monetary shocks. Nonetheless, the results are not specific to Mexico and are applicable to a wide range of partially dollarized economies.

Mexican banks are the second most important source of finance for firms (after suppliers) as shown in Table 1. The data are from a nation-wide survey of firms, which has been conducted quarterly by the Central Bank of Mexico since 1998. Commercial bank lending was the primary source of finance for 27% of firms in 1998, and declined to 19.2% by 2003 (if foreign banks and development banks are included, the share falls from 41% to 25%). The remaining sources of funds are the parent company, other banks in the corporation, and other liabilities (the latter are less than 2%). Therefore, capital market financing is negligible.

Table 1. Sources of financing for firms (% of responses)

	1998	1999	2000	2001	2002	2003
Suppliers	40.4	47.4	50.5	53.5	56.1	57.2
Banks	40.9	35.3	31.9	28.8	26.4	25.0
Commercial banks	27.0	25.0	23.3	21.2	19.7	19.2
Foreign banks	9.6	7.4	6.3	5.4	4.4	3.5
Development banks	4.3	2.9	2.3	2.2	2.3	2.4
Associated firms	16.3	15.8	16.2	15.9	16.4	16.1
Other liabilities	2.4	1.6	1.5	1.8	1.2	1.6
Share of financing from commercial banks						
Small firms	23.9	20.9	17.6	17.5	15.7	15.1
Large firms	32.1	33.0	34.1	30.8	32.3	41.2

Notes: Nationwide sample with responses from at least 500 firms. Survey is done quarterly, 2003 is for the first three quarters. Small firms: sales in 1997, 1 to 100 million pesos. Large firms: sales in 1997, over 5,000 million pesos. Source: Credit Market Surveys, Bank of Mexico website, http://www.banxico.gob.mx.

This paper does not focus on the downward trend in credit witnessed over this period.[6] I do not make the strong claim that a currency-sensitive bank lending channel (or even a conventional lending channel) was the principal driver. Arguably, other reasons including weak bank capital positions, non-performing loans, and anemic loan demand were important factors behind these longer run trends. The empirical analysis in Section IV controls for many of these factors, and relies on cross-bank variation in addition to the time variation.

Table 2. Reasons for not obtaining bank credit (% of responses)

	1998	1999	2000	2001	2002	2003
High interest rates	30.9	34.2	35.1	29.8	25.3	22.3
Demand problems for their products	6.8	3.9	3.4	4.9	5.0	6.0
Bank's unwillingness to lend	15.5	19.9	19.0	15.7	18.4	12.9
Economic uncertainty	17.6	13.4	15.4	20.2	21.3	23.3
Financial restructuring difficulties	8.2	10.4	9.1	9.4	11.7	9.7
Application rejected	5.4	4.4	6.0	7.5	9.0	9.1
Past-due loan portfolio	6.2	6.5	5.8	4.4	4.4	3.4
Market competition difficulties	4.9	3.9	4.5	4.8	4.3	4.7
Other	4.6	3.6	1.7	3.5	0.7	8.5

Notes: Asked of those that did not use bank credit. Nationwide sample with responses from at least 500 firms. Survey is done quarterly, 2003 is for the first three quarters. Source: Credit Market Surveys, Bank of Mexico website, http://www.banxico.gob.mx.

Nonetheless, the findings in Table 2 point to the importance of credit market frictions, and it is interesting to briefly pause on credit conditions in Mexico during this time period. The most frequently cited reason for firms not using bank credit was high interest rates, although it declined in importance over time. The next two most important reasons were the increase in economic uncertainty and banks' unwillingness to lend. Therefore, the survey evidence suggests that credit supply factors were an important factor behind the stagnation in Mexican output

[6] It may be that the decline in lending is simply a return to a normal state following Mexico's lending boom from 1988 to 1994 identified by Gourinchas et al. (2001) — although they define a lending boom to include both the build-up and ending phase. But that is not likely. If one compares bank credit to the private sector to other countries, Mexico lags behind other middle and high income countries. For example, the average as a share of GDP from 1960 to 2004 was 22.5% in Mexico compared with 39.2% in other middle income countries (*World development indicators*).

in the early 2000s.[7] Even the earlier recovery from 1996 to 2000 was a differential recovery that favored large and tradable firms.[8] For example, an uneven recovery can be due to differences in the tradable sector's access to finance compared with the bank-dependent nontradable sector in middle-income countries (e.g., Tornell and Westermann 2002; Krueger and Tornell 1999). Banks were, arguably, also suffering from the rise in non-performing loans and collateral problems following the credit boom and ensuing crisis in 1994 (e.g., Dornbusch and Werner 1994; The Economist 2000).[9]

B. Monetary policy

Monetary policy targeted the monetary base initially in 1995 (Carstens and Werner 2000). Later, the Bank of Mexico moved to a more discretionary policy. The main instrument by which it signals its intended interest rate has been the "corto". The "corto" refers to the (negative of the) total net balance of current accounts that credit institutions hold at the central bank. The aim is not to maintain consistently positive balances in the current accounts, and thus forego interest. Therefore, there is no formal reserve requirement and the system is referred to as a "zero-average reserve requirement system". If the accumulated settlement balance of a bank at the end of each 28-day accounting period is less than zero, the bank will be forced to pay high interest rates on the corresponding balance. There is no charge for such an overdraft if it occurs within the period (subject to certain limits).[10]

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[7] After averaging 5.5% from 1996 to 2000, GDP growth reached a low of -0.2% in 2001 and averaged 0.7% from 2001 to 2003. Only in 2004 did output begin to recover. Industrial production suffered even more, declining year-on-year 3.5% in 2001 and continuing to decline through 2003. (Source: Instituto Nacional de Estadística, Geografía e Informática (INEGI), http://www.inegi.gob.mx/).

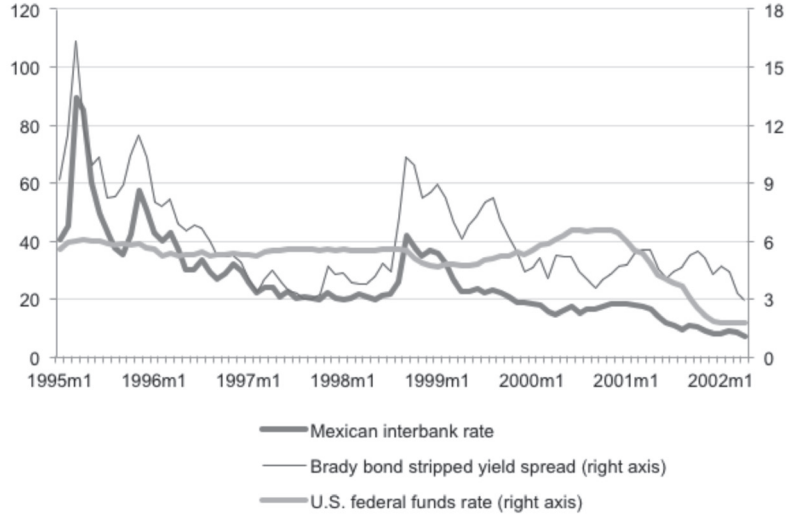
[8] For example, small firms perceived greater credit rationing than larger firms (19.7% compared with 13.4%) until 2003 when small firms began to perceive more favorable conditions (responses are also derived from the Credit Market Survey). This coincided with the turnaround in GDP.

[9] While the reliance of banks on collateral such as real estate is not a problem in an environment of idiosyncratic shocks, it can be a problem in a systemic crisis like the 1994 tequila crisis (e.g., Caballero 2000).

[10] It remains possible to study the lending channel when there is no legal reserve requirement in place. Stein (1998) points out that the bank lending view is valid in an economy in which some bank liabilities are insured but are not subject to legal reserve requirements. The key point is for banks to have a reason (whether legal or technological) to hold non-interest bearing reserves to accommodate unpredictable withdrawals by depositors. In this case, the reserve requirement ratio can be interpreted as a fixed coefficient "deposit-production technology" for reserves.

A zero target for the "corto" indicates the Bank of Mexico's intention to meet at market rates the full demand by banks for cash, so that the system as a whole does not register overdrafts or accumulate positive balances. A positive "corto" is defined as a *negative* objective for total accumulated bank balances. Therefore, the "corto" and the market interbank rate are positively correlated. The central bank documents the effectiveness of the "corto" in inducing the desired change in the market interest rate. I will therefore use the short-term interbank interest rate as a proxy for the stance of monetary policy in the empirical analysis.[11] Specifically, the 28-day interbank interest rate shown in Figure 1 is used. Aside from the 1994 to 1995 crisis period, the interbank rate has steadily declined, with the exception of mid-1998 to early 1999 when the Russian and Brazilian crises led to higher interest rates.

Figure 1. The interbank rate, the Brady bond stripped yield spread and the U.S. federal funds rate



Source: IFS series 60b..zf (tasa de interes interbancaria de equilibrio) for the Mexican interbank rate and series 11160b..zf for the U.S. federal funds rate; Datastream series 187419(BY) for the Mexican Brady bond stripped yield (on Mexico Par 6 1/4% 31/12/19 S) and series USBD30Y(RY) for U.S. government bond of comparable maturity to calculate the stripped yield Brady bond spread.

[11] It is worth noting that the Bank of Mexico has since moved to an inflation targeting regime. Beginning in December 2003, the inflation target was 3% with ±1% variability.

Figure 1 also shows the two other shocks used in the analysis, the U.S. federal funds rate (the interbank rate) and the Mexican Brady bond stripped yield spread. Brady bonds were issued as part of Mexico's 1990 debt restructuring of external commercial bank loans into tradable instruments with an original expiration in 2019. These guaranteed instruments from mainly Latin America are highly liquid and form a large part of JP Morgan's Emerging Market Bond Index. The stripped yield spread means that the yields are calculated after the value of the collateral has been subtracted from the value of the bond. As with other emerging market economies, the domestic interest rate follows a similar pattern to that of country risk, particularly during crises, and it is therefore important to separate out the source of shocks in the analysis.

As previously mentioned, one advantage of the Mexican setting during this time period is that domestic monetary policy is not strongly related to foreign monetary policy as measured by the dynamics of the U.S. federal funds rate. Moreover, the empirical analysis employs orthogonalized structural shocks, which are derived from a VAR. The VAR includes the domestic interest rate, the foreign interest rate, and the country risk shock.[12] Figure 2 traces the impulse response of the domestic interbank rate to a one standard deviation shock to, respectively, the U.S. federal funds rate, the Brady bond spread, and the domestic interbank rate. Panel A shows the response of the domestic interbank rate to the U.S. federal funds rate, which is positive but with wide standard error bands around the point estimates. And as expected (in results not shown), the impulse response of the U.S. federal funds rate to a shock to the Mexican interbank rate is virtually zero. Therefore, there is an overall weak relationship between the foreign and domestic interest rate policies. Panels B and C show that the domestic interbank rate responds positively and significantly to shocks to the Brady bond spread and to itself. The response is also persistent, lasting close to six months.[13]

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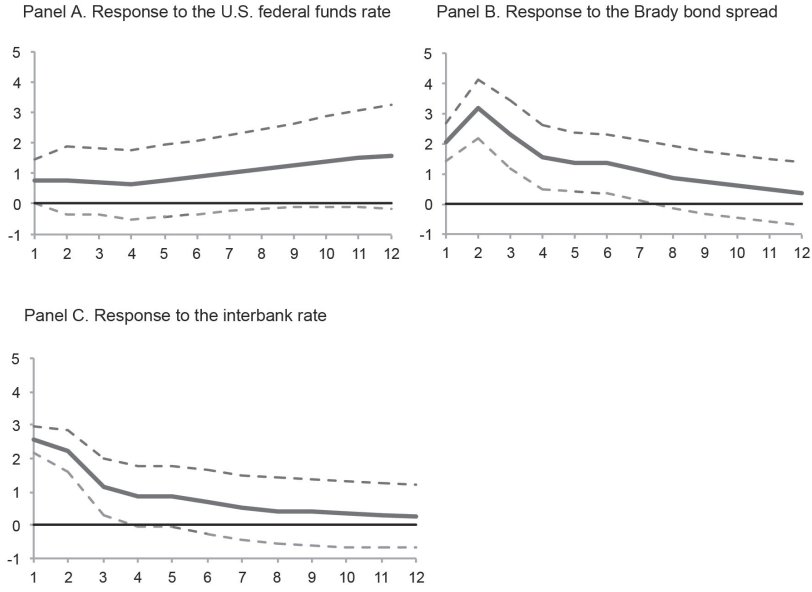
[12] The VAR model was estimated with three lags (monthly) and the orthogonal shocks were then derived using a Choleski decomposition. The ordering was U.S. federal funds rate, Brady bond stripped yield spread, and peso interbank rate. This ordering means that the federal funds rate affects the other variables contemporaneously and with a lag, but is not affected by them within the same month, which is very reasonable. Note that the results in the next section are similar with a different plausible ordering: U.S. federal funds rate, peso interbank rate, followed by the Brady bond spread. And the impulse responses of the interbank rate to the different shocks are also similar under the two orderings.

[13] Also note that the Brady bond spread responds negatively to the domestic interest rate, which is in line with the view that active monetary policy tightening reduces country risk and, therefore, lowers sovereign bond spreads.

Figure 2. Impulse responses of the interbank rate to one standard deviation innovations (over a horizon of 12 months)



Note: The solid line represents the impulse response to a one standard deviation shock to the respective variable. The shocks were derived from a Choleski decomposition, in the order U.S. federal funds rate, Brady bond spread, and the interbank rate. The dashed lines show the ± 2 standard errors around the impulse response.

III. Econometric design

A. The specification and its motivation

The first empirical question is to quantify the effect of domestic monetary policy shocks on bank deposits via the currency composition of deposits. That is, are banks with a larger proportion of foreign currency deposits less sensitive to domestic monetary policy shocks? The empirical methodology is closely related to the interaction specification applied by Kashyap and Stein (2000) on U.S. individual banks and takes advantage of both the cross-sectional and time-series properties of the data. Kashyap and Stein (2000) identify the bank lending channel by showing that a contractionary monetary shock has a greater effect on less liquid banks. That is, comparing two otherwise identical banks, the bank with a less liquid balance sheet position will be forced to absorb the shock by cutting loans more because it cannot as easily draw on a liquid buffer.

In my methodology, I compare two identical banks, except that one has an initially larger share of foreign currency deposits compared with the other (say, because a large part of this bank's branches are in geographical proximity to the U.S.) The first regression estimates the effect of monetary policy on the growth in total bank deposits. A simple interactive panel regression for the growth in deposits of bank *j* at time *t* is specified as follows,

$$\Delta \log D_{j,t} = \gamma + \sum_{k=1}^{l} \alpha_k \Delta log D_{j,t-k} + \sum_{k=0}^{l} \mu_k PESO_{t-k}$$

$$+ \; FXD_{j,t-1}(\eta_D + \sum_{k=0}^{l} \varphi_{Dk} \; PESO_{t-k}) + \delta Z_{j,t} + \varepsilon_{j,t} \; , \qquad (1)$$

where *D* is the total real deposit volume, *FXD* is the share of foreign exchange deposits in total deposits, *Z* is a vector for other controls (this may also include interaction terms with other bank characteristics such as a bank's liquidity so that the Kashyap and Stein test is nested within this specification), and *l* is the number of lags. *PESO* is the domestic interest rate shock.

The prediction is that $\sum_{k=0}^{l} \varphi_{Dk} > 0$ for the peso shock. That is, banks cannot perfectly undo deposit preference shifts by households. Therefore, a bank with a larger share of foreign currency deposits will experience less of a decline in its total deposits following an increase in the interbank peso interest rate than a bank with a smaller share of foreign currency deposits. This hypothesis follows from the outcomes of both the household portfolio choice and the bank portfolio choice, which are briefly described in what follows (see the online appendix for more detail).

First, household portfolio choice can be modeled as the outcome of a household utility maximization problem, solving for the optimal holdings of domestic bonds, domestic currency deposits and foreign currency deposits adopting the money-in-utility approach (Sidrauski 1967).[14] The first order conditions imply

[14] Deposits are positively demanded because of money-in-utility preferences. The domestic currency bond earns interest but not domestic and foreign currency deposits (money). This is a reasonable empirical approximation for Mexico where the compensation for holding domestic currency deposits relative to foreign currency deposits was less than that implied by the differential between the interbank rate and the U.S. federal funds rate. For example, the difference between the peso rate and the federal funds rate averaged 16.1% from April 1996 to April 2002, compared with only 12.3% for the difference between term peso and foreign currency deposits. And when the expected peso depreciation reached 36.5% in September 1998, the term deposit rate differential adjusted to only 23%. Moreover, the term

that an unanticipated contractionary monetary policy leads to less of a decline in foreign currency deposits than in domestic currency deposits because of i) an implied exchange rate depreciation that causes households to increase the relative share of foreign currency deposits in their deposits and ii) exchange rate risk implies that households are less likely to shift out of foreign currency deposits into domestic bonds than out of domestic currency deposits because the former provide households with a hedge against exchange rate risk which cannot be done by holding domestic bonds.[15]

The hypothesis is completed by the outcome of bank portfolio choice, where banks are constrained by regulation, geography, and technology in their ability to offset domestic currency deposit shocks with foreign currency deposits. That is, differences in deposit responses to monetary policy shocks are only economically interesting if frictions prevent banks from absorbing a loss in domestic currency deposits by increasing foreign currency deposits and other funds. As shown by Bernanke and Blinder (1988, 1992) and Kashyap and Stein (2000), banks are unable to perfectly substitute between deposits and other sources of uninsured funds, due to the failure of the Modigliani-Miller theorem.

In the context of dollarization, I argue that banks cannot frictionlessly substitute between domestic currency and foreign currency deposits. The key ingredient for a currency-dependent lending channel is that banks face differential costs in intermediating domestic currency versus foreign currency deposits. The case of Mexico provides an exogenous geographic driver of differences across banks. Restrictive legislation was passed in 1995 (see Bank of Mexico Circular 2019/95) in the aftermath of the 1994 crisis, limiting holders of dollar deposits to: (1) residents of the 20 kilometer strip along the northern border area of Mexico or living in Baja California or Baja California Sur, or (2) firms domiciled anywhere in Mexico. The first part of the legislation, which concerns residents, is a geographical restriction. Banks located in these regions (or with more branches in these regions) will be able to intermediate foreign currency deposits made by local residents.[16]

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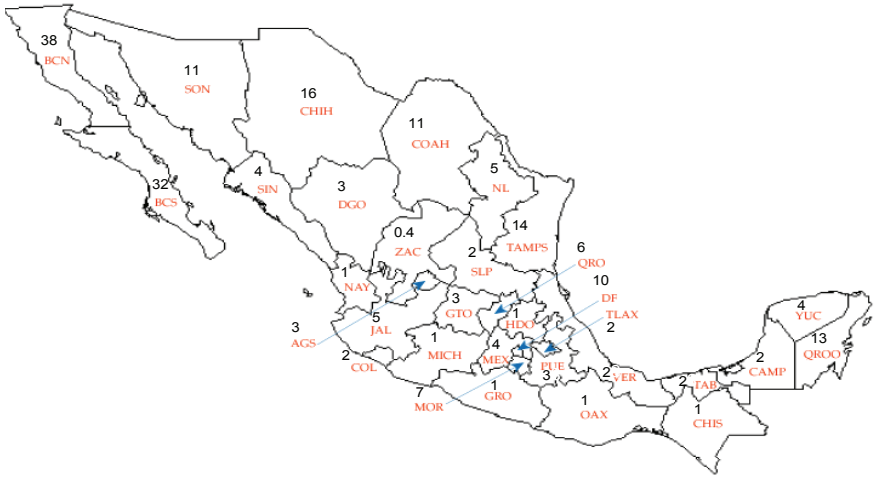
deposit rate is an upper bound because demand deposits, offering greater liquidity services, earn little or no interest.

[15] This second effect can also be modeled explicitly using a mean-variance utility approach (Dornbusch 1983; Ize and Levy-Yeyati 2003).

[16] While large banks in Mexico operate at the national level, smaller banks can be geographically concentrated. For example, the six large banks have on average over 1200 branches distributed throughout the 32 Mexican states, with roughly a quarter of their branches in states along the U.S. border (Table 3). In contrast, there is much greater variation among the smaller banks, discussed in Section III.B.

In addition, the second part of the Mexican legislation is a regulatory restriction, in that firms domiciled anywhere in Mexico can hold foreign currency deposits. If firms deposit at banks from which they also obtain credit (the corporate finance literature supports this view), then banks that are better able to lend in foreign currency are expected to have a larger share of foreign deposits.

Figure 3. Foreign deposit share, December 2001 (in percent)



Notes: AGS Aguascalientes, BCN Baja California, BCS Baja California Sur, CAMP Campeche, CHIH Chihuahua, CHIS Chiapas, COAH Coahuila, COL Colima, DF Distrito Federal, DGO Durango, GRO Guerrero, GTO Guanajuato, HDO Hidalgo, JAL Jalisco, MEX México, MICH Michoacán, MOR Morelos, NAY Nayarit, NL Nuevo León, OAX Oaxaca, PUE Puebla, QRO Querétaro, QROO Quintana Roo, SIN Sinaloa, SLP San Luis Potosí, SON Sonora, TAB Tabasco, TAMPS Tamaulipas, TLAX Tlaxcala, VER Veracruz, YUC Yucatán, ZAC Zacatecas. Source: Banxico Dirección General de Investigación Económica. Indicadores económicos, March 2002. Bank of Mexico website.

Figure 3 shows the share of foreign currency deposits in each of the 32 Mexican states, as of December 2001 (data are only available for aggregate deposits at the state-level and are not available at the branch-level). The illustrative evidence supports these two candidate explanations. The share of foreign currency deposits is largest in the two states of Baja California and Baja California Sur at 38% and 32% respectively, compared with a country-wide share of 11%. The remaining five states bordering the United States (Chihuahua, Tamaulipas, Sonora, Coahuila, and Nuevo León), follow Baja California Sur in the share of foreign currency deposits, with the exception of Nuevo León that has a very small border area compared with the other states. The other states with relatively high foreign deposit shares are close to the capital (Federal District, Morelos, Querétaro) or in the export

and tourism regions (Quintana Roo, Yucatán, Jalisco). These are both locations in which higher credit in foreign exchange is expected.

The second regression, therefore, provides a test of the bank lending channel in a partially dollarized economy. Specifically, this specification shows how the lending channel works through the currency composition of bank deposits. In this case, the growth in bank loans is modeled as:

$$\Delta \log L_{j,t} = \gamma + \sum_{k=1}^{l} \alpha_k \Delta log L_{j,t-k} + \sum_{k=0}^{l} \mu_k PESO_{t-k} + FXD_{j,t-1}(\eta_D + \sum_{k=0}^{l} \varphi_{Dk}\ PESO_{t-k}) +$$

$$FXL_{j,t-1}(\eta_L + \sum_{k=0}^{l} \varphi_{Lk}\ PESO_{t-k}) + \delta Z_{j,t} + \varepsilon_{j,t}\ , \qquad (2)$$

and the prediction is also that $\sum_{k=0}^{l} \varphi_{Dk} > 0$ if banks cannot easily make up the shortfall in domestic currency deposits with other funds to support lending so that a higher foreign deposit share insulates a bank's lending from domestic monetary shocks. No *a priori* prediction can be made on the sign of the loan interactions, $\sum_{k=0}^{l} \varphi_{Lk}$, because of the theoretical ambiguity that the firm balance sheet channel takes in a dollarized economy (due to the ambiguous effect that monetary policy has on the external finance premium that firms pay on credit, where expansionary monetary policy may aggravate the dollar debt burden of firms thus decreasing their net worth).[17]

Note that real deposit (and loan) volumes are used in the analysis and not nominal values to avoid capturing spurious valuation changes such as those stemming from exchange rate fluctuations. To obtain real volumes, the peso-denominated items of the balance sheet are deflated by the Mexican consumer price index. The data set provided by the Bank of Mexico, however, reports foreign (dollar) denominated items in nominal pesos. Therefore, adjusted real volumes are calculated as the sum of the peso component deflated by the Mexican CPI and the dollar component deflated by the product of the (monthly end of period) exchange rate and the U.S. consumer price index (the results in Section IV are broadly similar when using unadjusted values because the underlying changes are preserved). Details on the other shocks and bank controls used in the vector Z are discussed in the next section. The thirteen bank mergers and acquisitions over the sample period

[17] See the online appendix as well as the related literature discussed in the Introduction.

were also accounted for in the regressions.[18] The empirical estimation is panel random effects, similar to Kashyap and Stein (2000). The sample is monthly. The standard errors computed are heteroscedasticity robust and are clustered at the bank level. The results are also robust to running fixed effects. However, fixed effects estimation does not take full advantage of the available cross-sectional variation.

B. Balance sheet data

Data on individual bank balance sheet items are from the Bank of Mexico. Monthly data from January 1995 to April 2002 are available for a total unbalanced panel of 56 banks. The peso denominated component and the foreign currency (dollar) denominated component are available for each balance sheet item. Table 3 and Tables A1–A2 present summary statistics for the principal balance sheet items and the main variables used in the regressions.[19] Big banks are defined as those banks above the 85th percentile in terms of the fraction of total real assets of the banking system over 1995-2002.[20] The Bank of Mexico reports current loans together with past due loans in the figure for "total loans". To get a more accurate measure of current loans, I therefore sum the sectoral components, which are available separately by current and past due status. Therefore, the series "current loans" reflects current loans to the private sector and is the sum of commercial loans, loans to financial intermediaries, consumer loans, and housing loans (also used in the empirical analysis). In line with the discussion in Section II.A, loans have steadily declined in recent years at both small and big banks but they comprise a similar share of assets (declining from about 50% in 1995 to 30% in 2002 for total loans and to 10%-14% in 2002 for current loans to the private sector).

Currency matching is evident at the aggregate level between total assets and liabilities. For example, the average share of assets and liabilities in foreign

[18] The merger dummy takes a value of one if there was an actual consolidation in balance sheets during that time period for the surviving bank and not just a replacement of the management of a bank. Regressions omit time periods in which a merger occurred as well as time periods affected by lags of the dependent variable.

[19] Tables A1 to A4 are in the online appendix.

[20] Specifically, these are Bancomer, Banamex, Serfin, Bital, Santander, Banorte, Inverlat, Bancrecer, and Citibank. They later consolidated into six banks because Bancrecer was acquired by Banorte (completed in April 2002), Citibank bought Banamex in November 2001, Santander bought Serfin, and HSBC took over Bital later in 2002. Big banks account for approximately 75% of total banking system assets.

currency for big banks was 28% in January 1995. This decreased to 12% by the end of the sample in April 2002. Small banks were not as perfectly matched. A greater share of their assets were in foreign currency compared with their liabilities (17% and 11%, respectively, in January 1995 and narrowing to 16% and 14% by the end of the sample). Table 3 shows the share of foreign currency loans in current loans and the share of foreign currency deposits in total deposits. A larger share of loans is denominated in foreign currency than are deposits, for both types of banks. The deposit share is approximately 15%, which was relatively stable over the sample period. However, the foreign currency share of current loans, averaging roughly 30%, declined for both groups of banks to around 20% by the end of the sample. The main liability supporting the higher share of foreign currency loans was interbank loans. For example, among small banks in 1995, the sum of the share of assets in foreign currency deposits and interbank loans equaled 10.6%, which closely matches the 10.1% share of assets in foreign currency loans.

Table 3. Summary statistics of foreign currency deposits and loans

	Observations	Mean	Standard deviation	25th percentile	Median	75th percentile
Share of deposits in foreign currency (cross-bank)	56	0.153	0.166	0.036	0.101	0.196
if small bank sample only	47	0.151	0.179	0.013	0.093	0.197
if big bank sample only	9	0.163	0.056	0.139	0.180	0.195
Share of loans in foreign currency (cross-bank)	56	0.286	0.204	0.129	0.269	0.448
if small bank sample only	47	0.266	0.214	0.064	0.245	0.445
if big bank sample only	9	0.393	0.066	0.383	0.399	0.451
Location of foreign currency deposits						
Number of branches, small banks	9	44.8	45.5	7.0	36.0	72.0
Number of branches, big banks	6	1216.8	467.4	978.0	1201.0	1564.0
Share of branches in border states, small banks	9	0.259	0.314	0.060	0.162	0.333
Share of branches in border states, big banks	6	0.255	0.031	0.226	0.261	0.272

Notes: Loans refer to current loans to the private sector (commercial, consumer, housing, and other financial intermediary loans). Big banks are banks above the 85 percentile of the fraction of total real assets of the banking system over 1995–2002. Data for location of bank branches are only available for 15 banks in the original sample, and come from the Association of Mexican Banks' *Directorio nacional de sucursales bancarias*, http://www.abm.org.mx, as of December 2007. Bank-level data on foreign currency deposits and loans are from Bank of Mexico.

These figures are overall reassuring for the hypothesis because foreign currency deposits and loans are *not* concentrated within, say, the big banks. There is considerable cross-bank variation (e.g., the cross-bank standard deviation of foreign currency deposit shares was 16.6%, ranging from 3.6% at the 25th percentile to 19.6% at the 75th percentile as shown in Table 3). It would be troubling if foreign currency deposits were mostly at big banks if they are deposited by large corporations. In that case, it would be difficult to argue that banks with large foreign currency deposits are immune to monetary shocks because of a currency-sensitive lending channel, and not because strong banks are simply better able to draw on their buffers or more easily access outside funds. Moreover, as mentioned in the previous section, Table 3 confirms the importance of geographic drivers of the foreign currency distribution, particularly among the small banks. On average, roughly a quarter of the branches of small and large banks are located in states along the U.S. border. But the standard deviation of the fraction of branches in border states is over 30% for small banks, while it is only 3% for large banks. For example, small banks such as IXE, Interacciones and Bajio have an average 78 branches of which only 12.2% are in the border area compared with 98.6% of Banregio's 72 branches located in border states.[21]

Other characteristics included in the analysis as controls for bank financial conditions, such as liquid assets, capital ratios, and past due loans, are summarized in Tables A1 and A2. Among these characteristics is an indicator for whether a bank was under the intervention of the Instituto para la Protección al Ahorro Bancario (IPAB), the Bank Savings Protection Institute, which was responsible for the bank bail-out after the peso crisis.[22] The regressions control for banks under IPAB control and the regression results in the next section are also robust to estimating only on the sample of non-IPAB banks.

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[21] This illustrative evidence on branches backs the evidence on the variation in foreign currency deposit shares, which are used in the empirical analysis. For example, the average share of deposits in foreign currency at IXE, Interacciones and Bajio in the period of study was 7.8% compared with 17.4% for Banregio. Intermediate cases like Afirme and Invex with 40% of their branches in border states had a foreign currency deposit share of 12.5%.

[22] I construct a bank-time varying IPAB dummy from various sources including a report sent by Bank of Mexico staff economists and the CNBV staff. Intervention accounted for 8.9% of the banks at the beginning of the sample and increased to 26.8% by January 1999 before gradually declining. Because a number of small banks were under IPAB intervention (13 of the 42 in 1999 and 12 of the 36 in 2002), their average liabilities as a fraction of assets expanded and their capital ratio equally turned negative. The average capital-to-asset ratio for non-IPAB banks was 11.4% over the sample.

IV. Results

A. Deposits

The evidence in this section assesses whether a greater foreign deposit share insulates a bank's deposits and lending activity from domestic monetary shocks. This section also sheds light on whether foreign currency deposits are less effective as a hedge against exchange rate risk during times of increased country risk. The risk of a forced conversion of foreign currency deposits into domestic currency may be the dominant effect during these periods. Responses to foreign monetary shocks are also evaluated.

Table 4 presents the results of the deposit regressions, relating changes in these loanable funds to monetary policy shocks according to the bank's initial deposit currency composition. Column (1) is the baseline regression, equation (1), estimated for all banks. The results strongly support the first part of the bank lending hypothesis. The coefficients on the interaction of the foreign deposit share with the peso shocks are positive and associated with a p-value well below 1%. Banks significantly lose deposits during periods of high interest rates, but less so for banks with a larger initial share of foreign currency deposits. Note that the coefficients of interest presented in the table are for the estimated $\sum_{k=0}^{l} \varphi_{DK}$ from equation (1) (and associated with the term labeled $FXD_{t-1}*PESO$). Following the lending channel literature, several lags of the peso interest shocks (and the other shocks) are included in the regression. Specifically, there are six lags, which is in line with the duration of the impulse responses in Figure 2. Therefore, the reported estimate associated with the $FXD_{t-1}*PESO$ term, 0.230, is the sum of the six estimated coefficients. Reported in parentheses below the interaction term is the p-value from the test that the sum of the coefficients is significantly different from zero (0.002).

The sum of the coefficients on the interaction of the foreign (U.S.) interest rate with the bank's foreign deposit share is negative, although not statistically significant at standard confidence levels. The direction of this result is the mirror image of the hypothesis for the domestic monetary shock. Finally, the sum of the coefficients on the Brady bond spread interaction term, $FXD_{t-1}*RISK$, is negative with a p-value below 1%. Therefore, there is evidence that depositors feared a conversion of their foreign deposits to domestic ones (presumably at a highly devalued level) when country risk was elevated.

Table 4. The effect of monetary policy shocks on bank deposits

Dependent variable:	(1)	(2)	(3)	(4)
log change in total real deposits, monthly	All banks	Small banks	Big banks	All banks
PESO (peso interest rate)	-0.043***	-0.045***	0.018**	-0.051**
	(0.002)	(0.002)	(0.030)	(0.010)
FXD_{t-1} (share of foreign deposits, lag 1)	0.074	0.074	-0.035	0.065
	(0.120)	(0.128)	(0.691)	(0.110)
$\boldsymbol{FXD_{t-1}*PESO}$	0.230***	0.237***	-0.091**	0.216***
	(0.002)	(0.002)	(0.045)	(0.007)
US (US interest rate)	-0.075	-0.101	-0.326***	-0.037
	(0.642)	(0.584)	(0.000)	(0.837)
RISK (Brady bond spread)	0.067*	0.067*	0.017	0.100**
	(0.051)	(0.083)	(0.373)	(0.011)
$FXD_{t-1}*US$	-0.261	-0.295	1.670***	-0.514
	(0.707)	(0.678)	(0.000)	(0.562)
$FXD_{t-1}*RISK$	-0.358***	-0.363***	-0.082	-0.517***
	(0.007)	(0.008)	(0.416)	(0.005)
E (exchange rate)				-3.961
				(0.101)
$FXD_{t-1}*E$				24.305
				(0.186)
IPAB	-0.068***	-0.077***	-0.013	-0.067***
	(0.001)	(0.001)	(0.109)	(0.001)
R-sq	0.053	0.055	0.179	0.060
N	3479	2798	681	3479
Banks	56	47	9	56

Notes: This table presents results from estimating equation (1) for deposit growth. The reported figures associated with the shock variables are the sum of the estimated coefficients on the contemporaneous and six lags of the respective policy shock variable (or on the interaction of the bank characteristic in question with the policy shock variable and its lags). Reported in parentheses below estimates are the p-values from the test that the sum of the coefficients is significantly different from zero, where ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors computed are heteroscedasticity robust, clustered at the bank level. IPAB is dummy for government intervention in a bank after 1995 crisis. Also included in regression are lags of the dependent variable and a constant. Regressions use VAR orthogonalized shocks. Deposits are in real terms, and are also adjusted for spurious valuation effects from exchange rate changes. Regressions with exchange rate use VAR shocks from the ordering: federal funds rate, spread, exchange rate, peso interest rate.

Columns (2) and (3) repeat the estimation for small banks and big banks, separately. If there were a bias in the baseline estimates because big banks happened to have a larger share of foreign deposits (this is, however, not the case as shown in Table 3), then the effect would be expected to be weaker among the subset of small banks. This is not the case as shown in column (2). The coefficients and their significance are largely unchanged for small banks. What is interesting is that the results are, if anything, negative for the subset of big banks. A similar result was found by Kashyap and Stein (2000), among others, leading them to argue that the small-bank to big-bank differential economic effect is even larger. This finding (together with an insignificant lending result for big banks later discussed in Table 5) can be explained by a Modigliani-Miller argument. Big banks are better able to adjust their funding compared with small banks when faced with portfolio rebalancing shifts by depositors. Therefore, the assumption that banks are not able to perfectly undo deposit shocks is important for small banks but not for big banks, which supports the theory and the empirical literature. It also supports the illustrative branch-level evidence in Section III that showed that big banks operate at the national level and are not as geographically concentrated.

One competing explanation is that the peso shock used to proxy for monetary policy may be, nonetheless, contaminated with other shocks, despite its orthogonality to the U.S. federal funds rate and the Brady bond spread. It would therefore be incorrect to attribute such shocks to monetary policy if, for example, exchange rate shocks are primarily responsible for deposit and lending differences. While it may not be possible to perfectly separate independent monetary policy shocks from exchange rate shocks, the exchange rate shock is added to the set of the three shocks in the VAR in column (4). The competing effect is captured by the interaction term, $FXD_{t-1}*E$. While the depreciation effect is also positive, the peso interest rate shock retains its economic and statistical significance, even when the exchange rate shock is ordered before the interest rate shock as shown. For example, the coefficient on $FXD_{t-1}*PESO$ is now 0.216 compared with 0.230 in column (1).

Results of additional robustness checks including other bank characteristics are in Table A3. One potential endogeneity issue is that "strong" banks — those which are more liquid, more capitalized, or have less past due loans — are better able to adjust to domestic monetary policy shocks. This ease of adjustment may be picked up by the foreign currency deposit share if the latter is endogenous (though this is a mitigated concern in the case of Mexico for the regulatory and geographic reasons outlined). Therefore, the basic specification was re-estimated

including the respective lagged bank characteristic and its interaction with the peso shock. The baseline results are robust to these additional controls, and while the interactions of these variables with the interest rate shock have the expected sign, none of the interactions are statistically significant. Therefore, one can conclude that deposits and by extension, potential loanable funds are affected by monetary shocks through the initial currency composition of deposits. In addition, Section IV.C later explores whether the currency-sensitive lending channel attributed to monetary policy may in fact be capturing the differential sensitivity of banks to the general business cycle. This turns out not to be the case.

B. Loans

Turning to the second and important part of the hypothesis, Table 5 presents the results of the loan regressions, equation (2). Column (1) reports the estimates for all banks. The evidence suggests that a currency-sensitive lending channel exists. The sum of the coefficient estimates on the interaction of the peso interest rate shocks with the foreign currency deposit share is positive, equal to 0.118, and significant at the 1% level. Columns (2) and (3) estimate the loan specification for small banks and big banks, respectively. As expected, the lending channel is concentrated among the small banks. Note also that the interest rate shock appears to have an insignificant effect on bank lending for a bank with no dollar deposits (isolating the sum of the coefficients only on the peso interest rate shocks, *PESO*). In contrast, as expected, positive interest rate shocks had a sizable and significantly negative effect on deposits (Table 4). However, the coefficient on the peso interest rate shock in the loan regression captures its joint effect on loan supply and loan demand. The effect on demand is ambiguous in a dollarized economy as discussed earlier. The effect on the interaction of the foreign currency loan share with the peso interest rate shock is found to be negative, also suggesting possible adverse effects from the firm balance sheet channel.[23]

[23] For example, if banks with a larger share of foreign exchange loans cater to firms that also have a larger share of foreign exchange debt, then tight money associated with an exchange rate appreciation affects the valuation of a firm's debt if it is not hedged. But exchange rate changes also affect firm revenue and export firms may be adversely affected by the contractionary policy due to the appreciation.

Table 5. The bank lending channel and the share of foreign currency deposits

Dependent variable:	(1)	(2)	(3)	(4)
log change in total real current loans, monthly	All banks	Small banks	Big banks	All banks
PESO (peso interest rate)	0.011	0.011	-0.023**	0.009
	(0.457)	(0.357)	(0.037)	(0.734)
US (US interest rate)	0.234	0.286*	0.020	0.186
	(0.106)	(0.098)	(0.844)	(0.282)
RISK (Brady bond spread)	0.037**	0.042**	-0.027	0.035*
	(0.049)	(0.041)	(0.444)	(0.082)
FXD_{t-1} (share of foreign deposits, lag 1)	0.076	0.082*	0.009	0.063
	(0.101)	(0.099)	(0.803)	(0.114)
FXD_{t-1}*PESO	0.118***	0.126***	-0.093	0.173**
	(0.001)	(0.001)	(0.169)	(0.022)
FXD_{t-1}*US	-0.279	-0.288	0.016	-0.265
	(0.561)	(0.556)	(0.982)	(0.621)
FXD_{t-1}*RISK	-0.221***	-0.227***	0.068	-0.230***
	(0.002)	(0.002)	(0.691)	(0.002)
FXL_{t-1} (share of foreign loans, lag 1)	-0.028	-0.030	0.013	-0.022
	(0.387)	(0.380)	(0.444)	(0.465)
FXL_{t-1}*PESO	-0.071	-0.075	0.073***	-0.093
	(0.145)	(0.155)	(0.000)	(0.191)
E (exchange rate)				0.758
				(0.411)
FXD_{t-1}*E				-3.068
				(0.367)
IPAB	-0.031***	-0.033**	-0.013*	-0.031***
	(0.004)	(0.013)	(0.053)	(0.003)
R-sq	0.053	0.055	0.202	0.059
N	3506	2825	681	3506
Banks	56	47	9	56

Notes:This table presents results from estimating equation (2) for loan growth. The reported figures associated with the shock variables are the sum of the estimated coefficients on the contemporaneous and six lags of the respective policy shock variable (or on the interaction of the bank characteristic in question with the policy shock variable and its lags). Reported in parentheses below estimates are the p-values from the test that the sum of the coefficients is significantly different from zero, where ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors computed are heteroscedasticity robust, clustered at the bank level. IPAB is dummy for government intervention in a bank after 1995 crisis. Also included in regression are lags of the dependent variable and a constant. Regressions use VAR orthogonalized shocks. Loans are in real terms, and are also adjusted for spurious valuation effects from exchange rate changes. Regressions with exchange rate use VAR shocks from the ordering: federal funds rate, spread, exchange rate, peso interest rate.

The magnitude of the bank lending channel is also economically significant. One can compare the response of two banks with different foreign currency deposit shares, one at the 75th percentile and the other at the 25th percentile (based on Table 3), in a similar exercise to what Kashyap and Stein (2000) carry out on liquid banks. Six months after a nominal interest rate increase of 100 basis points, lending by the 25th percentile bank will be 4.5% lower than the 75th percentile bank.[24] Among the subset of small banks, lending by the 25th percentile bank will be 5.6% lower than the 75th percentile bank. Since bank-dependent borrowers face frictions in switching between lenders, the distribution of credit and how it changes in response to monetary policy shocks is important.

Turning to the other shocks, the effects on lending activity is similar to that found on deposits. For example, the sum of the coefficients on the Brady bond spread interaction term, $FXD_{t-1}*RISK$, is negative with a p-value below 1%. Therefore, bank lending absorbs adverse shocks to loanable funds stemming from heightened country risk. In addition, the lending results are robust to the inclusion of exchange rate shocks (column (4)) and to controlling for the bank's liquidity, capitalization, and past due loan positions (Table A4). Kashyap and Stein's (2000) hypothesis receives some support based on the estimate of the bank's liquidity position interacted with the peso interest rate. Lending by banks with a larger share of liquid assets is less sensitive to monetary shocks. Well-capitalized banks are also less vulnerable to monetary contractions. And banks with more past due loans typically decrease lending growth (a one standard deviation increase in the past due loan share is associated with a statistically significant 1% lower lending growth) and also cut back more when monetary policy is tight.[25]

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[24] Note that the orthogonal shocks from a VAR are used as right-hand side variables in the regressions. Therefore a one standard deviation in the (standardized) orthogonal peso shock translates into an instantaneous one unit increase in the peso interest rate from the impulse response function. Since the non-standardized shocks were used in the regressions, the coefficients on the peso shock need to be multiplied by its standard deviation which is 2.4 (Figure 2 and Table A2). Therefore the 4.5% figure for the differential impact comes from multiplying the $\sum\phi_D$ in Table 5, column (1), by the standard deviation of the shock and then by the difference in foreign deposit share between the 75th and 25th percentile bank, (0.118×2.4×(0.196 - 0.036)). Note this does not account for the dynamic effects from the lagged dependent variable.

[25] I also compared the response of domestic-owned to foreign-owned banks. Foreign-owned banks should be less sensitive to domestic monetary shocks because of access to parent bank funding. The results indicate that (on the lending side) foreign-owned banks are actually more sensitive. This is at first puzzling but is likely due to the fact that many foreign-owned banks were acquisitions of domestic banks with solvency problems. As such, it is not an a priori set of strong banks. Some faced difficulties at the time (e.g., BNP's license was revoked in 2001).

C. Robustness checks of a competing story: the firm balance sheet channel

Finally, this section evaluates whether the firm balance sheet channel can be plausibly reconciled with the findings. This main alternative explanation is that the demand for credit, not the supply of loans, is responsible for the results. For example, contractionary monetary policy may impact a borrower's net worth negatively, thereby exacerbating its liquidity constraints and affecting its investment decisions and loan demand. These balance sheet constraints make it more difficult for borrowers to obtain any external credit, not just bank credit. To test whether such a balance sheet channel was responsible, Kashyap and Stein (1995) looked at the securities holdings of banks. If small banks cut their securities by more than big banks after a monetary policy contraction, this would be explained by the loan-supply channel (they find this to be the case). However, if lending by small banks decreases because of a disproportionate decline in their loan demand, they should instead increase their holdings of securities.

The demand for credit argument in the Mexican case rests on the assumption that there is a heterogeneous demand for credit by firms *within* the group of small banks (so it is a mitigated concern). It would also have to be correlated with the bank's foreign currency deposit share. Columns (1) and (2) of Table 6 report the results of regressions for small and big banks, respectively, in which the dependent variable is defined as (the growth in) the sum of a bank's cash and securities. When the interest rate increases, liquid assets go up but less so for more liquid banks (observed for both small and big banks). The interaction term of the interest rate shock with the foreign deposit share, $FXD_{t\text{-}1}*PESO$, is not statistically significant. Therefore, the results favor liquidity concerns of banks, and do not support the presence of heterogeneous demand for credit by firms matching to different banks.

A second approach to test for heterogeneous demand is to include an output shock to the set of shocks. Therefore, the last set of regressions includes industrial production, which is available monthly. The demand for credit story implies that industrial production shocks should be more likely to affect banks with a smaller foreign deposit share. This is because banks with a small foreign deposit share mostly cater to the non-tradable sector, which is the sector that should be most affected by domestic output shocks. In contrast, banks with a large foreign currency deposit share are oriented toward export firms, which are not as affected by domestic output shocks. Therefore, the coefficient on the interaction of the industrial production shock with the bank's foreign deposit share should enter negatively in the loan (and deposit) regressions.

Table 6. Robustness check of the bank lending channel: testing the firm balance sheet channel

Dependent variable:	(1)	(2)	(3)	(4)
monthly log change in	Liquid assets small banks	Liquid assets big banks	Deposits all banks	Loans all banks
PESO (peso interest rate)	0.000	0.015	-0.055**	0.007
	(0.998)	(0.733)	(0.044)	(0.818)
US (US interest rate)	-0.140	0.207	-0.240	-0.018
	(0.524)	(0.686)	(0.323)	(0.931)
RISK (Brady bond spread)	0.053	-0.056	0.172**	0.175**
	(0.149)	(0.439)	(0.036)	(0.035)
IP (Industrial production)			-5.734	-7.962
			(0.279)	(0.101)
FXD_{t-1} (share of foreign deposits, lag 1)	0.052	0.004	0.066	0.027
	(0.127)	(0.952)	(0.250)	(0.382)
FXD_{t-1}*PESO*	0.005	-0.005	0.248**	0.178*
	(0.914)	(0.966)	(0.014)	(0.069)
FXD_{t-1}*US*	-0.413	-0.848	-0.260	0.287
	(0.521)	(0.755)	(0.764)	(0.598)
FXD_{t-1}*RISK*	0.089	0.539	-0.127	-0.628*
	(0.488)	(0.224)	(0.682)	(0.079)
FXD_{t-1}*IP*			-22.732	14.677
			(0.294)	(0.419)
FXL_{t-1} (share of foreign loans, lag 1)				-0.014
				(0.664)
FXL_{t-1}*PESO*				-0.042
				(0.473)
LQD_{t-1} (Liquid assets to total assets, lag 1)	-0.336***	-0.120**		
	(0.000)	(0.045)		
LQD_{t-1}*PESO*	-0.013	-0.068		
	(0.846)	(0.545)		
IPAB	-0.030	-0.022	-0.064***	-0.025**
	(0.106)	(0.456)	(0.003)	(0.034)
R-sq	0.135	0.167	0.090	0.089
N	2829	681	3137	3175
Banks	47	9	55	56

Notes: The dependent variables are taken in growth rates (log change). The reported figures associated with the shock variables are the sum of the estimated coefficients on the contemporaneous and six lags of the respective policy shock variable (or on the interaction of the bank characteristic in question with the policy shock variable and its lags). Reported in parentheses below estimates are the p-values from the test that the sum of the coefficients is significantly different from zero, where ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors computed are heteroscedasticity robust, clustered at the bank level. IPAB is dummy for government intervention in a bank after 1995 crisis. Also included in regression are lags of the dependent variable and a constant. Regressions with industrial production use VAR shocks ordered: federal funds rate, spread, peso interest rate, industrial production.

Columns (3) and (4) of Table 6 report the results.[26] First, the significance of the peso interest rate shock is robust to the inclusion of the output shock. Second, the interaction of the foreign deposit share and the industrial production shock is negative in the deposit regression, as expected, but is not statistically significant. Nor is the effect significant on the lending side, where a positive shock to industrial production appears to increase lending activity even more at banks with a larger foreign deposit share. Collectively, these results do not square with a demand for credit story.

V. Concluding remarks

This paper introduces a novel bank lending channel in a partially dollarized banking system that works through the composition of deposits. In a partially dollarized economy, depository institutions cannot fully offset domestic currency deposit shifts with foreign currency deposits. In addition to the familiar credit market frictions that limit access to non-deposit funding, banks also face technological, regulatory and geographic differences that impede their ability to perfectly substitute between different currency liabilities. Thus, lending activity is forced to absorb domestic monetary shocks. The resulting channel is a potentially important channel of monetary policy transmission in many partially dollarized countries, which has been overlooked in the existing dollarization literature. This literature has focused on how monetary policy is amplified and propagated through the balance sheets of businesses.

There are two main implications. First, monetary policy will be less effective overall in a partially dollarized economy when it operates only on domestic liquidity. The second implication is that monetary policy can have significant distributional consequences to the extent that certain banks (and by extension, their bank-dependent borrowers) are more sensitive to domestic monetary shocks than are other banks. For example, an increase in the domestic interest rate means that bank lending will go down more in a rural state in central Mexico (such as Zacatecas) that relies on peso deposits than in the state of Baja California where banks are more dollarized. That monetary policy can have important real distributional effects propagated through the banking system has been emphasized

[26] The results hold whether industrial production is ordered before the interest rate or after it in the VAR. Note that the U.S. interest rate and the Brady bond spread continue to be ordered before the domestic interest rate shock.

by Kashyap and Stein (1997) in a paper on the implications of monetary union in Europe. Based on a simple construction of indicators for the degree of bank dependence and for the size distribution of banks and their health across countries, the authors find a weak lending channel in the UK, Belgium and Netherlands compared with a strong channel in Italy and Portugal. Distributional effects are potentially even greater in many emerging market countries.

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