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A Loan-level Analysis of Bank Lending in Mexico

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Abstract

We use loan-level data from the Mexican credit registry to study how bank-specific characteristics influence credit supply. We explore how these characteristics affect the transmission of monetary policy and their role in building banks' resilience to external shocks. Then, we compare the response of the credit supply of foreign subsidiaries to that of domestic banks. Finally, we study the impact of other micro characteristics on the credit supply and their influence on the transmission of shocks. Our results highlight the importance of banks' strong balance sheets and stable sources of funding for the provision of credit in Mexico. In general, these characteristics shelter banks from shocks.

1 Introduction

There was a substantial change in the structure of the global financial system and the interactions of its players after the great financial crisis (GFC). This change affected how banks fund their operations, grant credit, the business lines they engage in, and their response to monetary policy and external shocks. There is a growing body of literature on whether structural breaks after the GFC have changed how bank-specific characteristics affect loan provision. In Latin America, this area of research has taken advantage of the granularity provided by credit registry data. This paper seeks to contribute to the literature on the role of bank-specific characteristics on the supply of credit, and how these characteristics affect the relevant channels through which monetary policy and external shocks operate in the financial system. We focus on the Mexican banking system, which presents an interesting case given its high concentration and the participation of foreign subsidiaries of international banks.

Globalization prompted the internationalization of banks, which has affected financial systems in Latin America. Forty years ago the Mexican banking sector comprised mainly local suppliers and specialized intermediaries, and foreign competition was limited. Then, after the expropriation of banks in 1982, the public sector took on the task of providing banking services and the industry became fully state-owned. Nowadays, this industry is populated by both foreign and domestic corporations, with a greater proportion of them being foreign-owned. The defining changes in the banking sector were catalysed by the reforms implemented after the 1995 crisis and the signing of the North American Free Trade Agreement (NAFTA). These reforms accelerated the expansion of international banking, leading to a consolidation of the banking system. In recent years, the Mexican banking sector has grown at a steady pace, with the seven largest banks owning 80 percent of the system assets and with subsidiaries of international banks holding a market share of 65 percent (Graph 1).[1] More recently, the financial authorities have implemented a series of reforms aimed at enhancing competition and financial stability in the industry. The evaluation of the role of bank characteristics on the supply of credit is relevant for the proper implementation of policies that aim to foster a stable financial system.

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[1]There are no branches of foreign banks, authorities have only allowed subsidiaries to operate in the country. The 7 largest banks are: Banorte (Mexico), BBVA Bancomer (Spain), Citi Banamex (US), HSBC (UK), Inbursa (Mexico), Santander (Spain) and Scotiabank (Canada).

This paper has three aims. First, we study how banks' balance sheet characteristics amplify or dampen the effects of domestic and external shocks on the supply of credit in Mexico (eg. do well-capitalised banks react more or less sensitively to monetary policy shocks?). Second, we evaluate if foreign subsidiaries react more or less sensitively to domestic and external shocks compared to domestic banks. As part of this analysis, we assess how the response depends on foreign subsidiaries' balance sheet characteristics (eg. do well-capitalised foreign subsidiaries react more or less sensitively to monetary policy shocks compared to well-capitalised domestic banks?). Finally, we determine how other characteristics (loan, relationship, firm, and industry) weaken or strengthen the impact of domestic and external shocks on loan growth (eg. is the supply of credit to firms with stronger banking relationships more or less affected by monetary policy shocks?).

Our main results are the following. First, we show that banks with stronger balance sheets and with stable sources of funding supply more credit, whereas banks with higher risk indicators and a universal business model[2] grant less credit. Second, in general, characteristics that foster loan growth shelter banks from shocks. By contrast, characteristics that are negatively related to loan growth amplify the effects of shocks. Third, compared to domestic banks, foreign subsidiaries shrink their credit supply more actively when the economy is hit by shocks. However, in contrast to domestic banks, a universal business model and higher share of funding from foreign sources help subsidiaries react less sensitively to shocks. Fourth, there is a positive relationship between loan growth and high-quality creditors with strong relationships with banks. Additionally, the loan supply to these creditors is less affected by shocks. Finally, low competition in the banking industry has a negative relationship with loan growth but helps shield the system against shocks.

The paper is structured in the following way. Section 2 contains a short literature review. Section 3 presents an overview of the evolution of the Mexican banking system, highlighting the reforms that have shaped the industry. Section 4 describes the data used in the analysis. Section 5 explains the empirical strategy. Section 6 analyses the results and Section 7 concludes.

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[2]This model will be described later, but it is characterised by a business model less oriented to credit provision, with a greater reliance on non-interest income and a higher share of trading assets.

2 Literature Review

This paper contributes to the literature on the transmission channels of monetary policy and external shocks to the financial system. The bank-lending channel of transmission of monetary policy operates through banks' liability side. A tightening in monetary policy reduces reserves from the banking system and banks reduce lending as there are fewer loanable funds (Bernanke and Blinder (1988)). Kashyap and Stein (2000) find that smaller and less liquid banks in the United States react more to changes in monetary policy. For the Mexican case, Bank of Mexico (2017) analyzes the effects of unexpected monetary policy shocks on the supply of credit using loan-level data. They find that banks with a higher level of liquidity reduce less their credit supply in response to an increase in the policy rate. Levin, López and López-Gallo (2017) study the impact of the implementation of loan-loss provisioning rules in Mexico. They find that this policy had a negative effect on credit and the effect was larger for credit denominated in local currency compared to foreign-currency loans.

Other studies focus on the effects of foreign policies on domestic lending. Buch and Goldberg (2017), find that effects of prudential spillovers sometimes spill over borders through bank lending. They show that balance sheet conditions and business models drive the amplitude and direction of spillovers to lending growth rates. We corroborate these results and show that banks with strong balance sheets reduce less their credit supply when faced by monetary policy or global external shocks. Particularly for Mexico, Levin et al (2017) assess the inward cross-border spillover effect of prudential policies and find that the increase in capital requirements in the United States had a significant impact on bank lending in Mexico.

Our second contribution is to the literature on how foreign subsidiaries respond differently to shocks compared to domestic banks. Within this literature, Mexico is an interesting case of study given the strong presence of foreign subsidiaries (65% of the share of total banks' assets in the system). CGFS (2018) studies the implications of regulatory changes on bank lending in Mexico and focuses on the change in behaviour of foreign subsidiaries after the implementation of Basel 2.5, Basel III and the liquidity coverage ratio[3], using credit registry data. Their results suggest that post Basel III, foreign

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[3]LCR is defined as share of liquid assets by volatile liabilities and VaR of repos and derivatives.

subsidiaries decreased their credit growth rate more than domestic banks. We study the response of subsidiaries to domestic monetary policy shocks and find a similar result.

Other studies focus on how subsidiaries respond to foreign shocks. Morais et al (2015) use loan-level data to study how foreign monetary policy shocks affect lending by foreign banks in Mexico. They find that a softening of foreign monetary policy increases the supply of credit of foreign banks to Mexican firms. Additionally, they show that the supply of credit increases disproportionately more for borrowers with high ex-ante loan rates and high ex-post loan defaults, implying the existence of an international risk-taking channel of monetary policy. Also using loan-level data, Alcaraz et al (2018) assess how unconventional central bank intervention in Europe affect lending conditions in Mexico. They conclude that there are significant spillovers from headquarters to subsidiaries (and vice-versa) even with strict limits on internal transfers of capital and liquidity between entities. Our paper focuses on the effect of global shocks (risk, liquidity, economic policy uncertainty, and commodity prices) instead of foreign monetary policy shocks, but we find results consistent with the literature.

Our last contribution is to the literature on the benefits of relationship lending. Kysucky and Norden (2016) conduct a meta-analysis of 101 studies and find that long-lasting, exclusive, and synergy-creating bank relationships are associated with higher credit volume. They also find that the benefits are greater when bank competition is high and do not depend on the size of the firm.

3   Evolution of the Mexican Banking System

The Mexican banking system underwent an important transformation process the last 30 years. This transformation can be described as a process of consolidation and openness to foreign investors. There are three main stages in the evolution of the Mexican banking system. The first occurred after a change in banking law allowed the creation of *multibanks* in 1975, which paved the way for the emergence of universal banks (Del Ángel (2015)). The second stage initiated by the nationalisation of banks in 1982 and started the process of consolidation. Prior to the nationalisation there were 60 multipurpose banks in Mexico, their number was reduced to 18 by 1990 (Graph 1, left panel). A second effect of nationalisation was the development of the securities market

in Mexico. (Del Ángel et al (2005)). The government prohibited banks from offering other financial services other than banking; contributing to the development of other financial intermediaries such as brokerage firms (Del Ángel et al (2017))). A third effect was a contraction in bank lending to the private sector as the government imposed many constraints on the banking sector. These restrictions included reserve requirements, interest rate ceilings on bank deposits and loans, and lending quotas on high priority economic sectors. The process of reprivatization of commercial banks started in 1989. Mexico regained entry to international capital market and bank credit to the private sector increased dramatically (Graph 1, right panel). However, the legal and regulatory environment was not the best-suited to incentivise efficient lending and minimize risks.[4]

The last and most important stage in the transformation of the Mexican banking system occurred after the 1995 Mexican crisis. The Mexican government implemented several policies to prevent the collapse of the banking system. These included restrictive monetary and credit policies, measures to improve liquidity and capitalisation, debtor relief efforts, and the transfer of non-performing loans into public debt (Herández (2007). Additionally, a change in the terms of NAFTA allowed foreigners to invest in the banking sector and by 1998 all restrictions were lifted (Castellanos et al (2015)).[5]

The reforms enacted after the 1995 crisis strengthen the stability of the banking sector and paved the way for the inclusion of Mexico into the global financial system. These reforms made it possible for banks to face the GFC with elevated levels of high quality capital and liquidity. After the crisis, the financial authorities in Mexico implemented all the standards and recommendations of financial regulation that the international organisms proposed in response to the crisis. More recently in 2013, the Mexican authorities put into effect a series of reforms aimed at ensuring bank stability, competition, and promoting financial inclusion and economic development.

The number of banks has continued to rise in the past years, with the greatest increase in domestic banks (from 15 in 2003 to 29 in 2017 (Graph 2, left panel)). Financial deepening, measured as the ratio of credit to the non-financial sector to GDP, has also increased. Credit to firms constitutes

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[4]Haber (2005) estimates that the ratio of non-performing loans to total loans increased from 13.5 percent in December 1991 to 52.6 percent by December 1996).

[5] The number of foreign subsidiaries increased from 2 in 1994 to 17 in 1998 (Graph 2, left panel).

the largest share, followed by consumer credit (Graph 2, right panel). Bank credit accounts for about 58% of the total local non-financial private funding since the GFC. The next biggest funding source (21%) is the Mexican federal institute for workers' housing (INFONAVIT), therefore banks' role as lenders is the most relevant.[6] The continued growth in credit does not pose an imminent threat to financial stability given the high level of capitalisation of banks and their low share of riskier loans. The capital adequacy ratio has remained above 10 percent for the past ten years (Graph 3, left panel). Additionally, Mexican banks have a higher level of capital relative to risk weighted assets and a higher proportion of Tier 1 capital relative to total capital compared to global banks (Banco de México (2017)). Finally, the ratio of non-performing loans and write-off to gross loans has remained stable and below 3 percent (Graph 3, right panel).

Mexican banks rely heavily on demand and time deposits as their main sources of funding, which have been increasing as a share of total liabilities (Graph 3, left panel). After the GFC, banks proportionally reduced their operations with securities and derivatives and their market making activities. Instead, banks have increased their holdings of bonds, driven by higher issuance of domestic government debt. Greater access to international capital markets has allowed banks to increase their liabilities in foreign currency. Foreign currency mismatches in banks' balance sheets are not a concern since there are strict regulatory limits that prevent substantial imbalances (Graph 4, right panel). Given these limits, an increase in volatility of the nominal exchange rate has a limited negative impact on the financial results of banks. However, the increase in the share of derivative contracts in total liabilities indicates that banks have been increasing their hedge of foreign currency exposure.

Another consequence of the GFC was a change in banks' business models in Mexico. The structure of a bank, and what it does, is driven by factors such as market forces and regulation, but most importantly by the bank's management of its balance sheet. Hence, the bank's business model can be broadly defined by its funding and liquidity strategies, and its sensitivity to funding investment opportunities. Following a methodology similar to the one applied in the Basel Committee on Banking Supervision (BCBS)[7] we classify banks in Mexico into three categories: trading, universal and commercial banks.[8]

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[6]Data calculated using Banco de México's total credit to the non-financial sector.

[7]Saunt and Fub (2012)

[8]Another approach is to use statistical analysis to determine business models. Based

The analysis uses thresholds based on balance sheet data to determine the categories. In broad terms, *trading banks* have a high share of trading asset securities on their balance sheet, whereas *commercial banks* have a low share of trading account securities and a substantial share of loans on their balance sheet. *Universal banks* cover the middle ground.[9].

Graph 5 presents the transition banks' business models in Mexico during the last decade. Before the GFC, Mexican banks started to diversify their operations. The number of universal banks increased by 4 and the number of trading banks by 3. However, the GFC had a negative effect on banks' market making activities. Many global banks wound down or closed their trading desks in several locations around the world as a response to structural reforms. As a result, trading operations of global banks in Mexico were reduced. For example, Deutsche Bank and ING Bank closed their Mexican subsidiaries after the crisis. These two banks were very active in local debt and derivative markets. The number of trading banks fell to 1 and there was a substantial increase in commercial banks (to 22 in 2013 from 8 in 2007). During the past four years, the Mexican banking system recovered and became more sophisticated. Banks are increasing their market making activities and new trading banks have opened for operation. The number of commercial banks is higher than the number of banks with other business models. However, universal banks dominate the system, as their share of total assets is greatest. The next section explores formally how these changes in the Mexican banking system and banks' business models have influenced loan provision.

on balance sheet indicators a number of studies use cluster techniques to identify groups of banks that are similar. For example Roengpitya et al (2017) distinguish between retail-funded banks, whole-sale funded banks, universal banks and trading banks. Other examples include Ayadi et al (2015) and Margaerts and Vander Vennet (2016).

[9]Banks with a ratio of trading account securities to total assets of more than 30% are classified as trading banks with less than 30% and more than 2% are classified as universal banks; and banks with less than 2% as commercial banks.There were some additional adjustments made for the classification. Banks classified as either commercial or universal with a loan to assets ratio of less than 15% were excluded from the analysis. For some banks, there was no information on trading account securities. In this case, if the securities to asset ratio was greater than 15% the bank was classified as universal, otherwise it was classified as commercial

4 Data

In this study we use two data sets from *Comisión Nacional Bancaria y de Valores* (CNBV), Mexico's financial system regulatory and supervisory institution. The first one is a credit registry (R04C report) of all the commercial loans from banks to firms between September 2009 and December 2017 in a quarterly basis[10]. This report contains the current status of all loans given by commercial banks operating in Mexico to firms and individuals with commercial activity.[11] Then, we construct a subsample that considers only firms that have multiple loans from more than one bank (MBR database). With this database we can disentangle credit supply shifts from credit demand shifts by introducing time-variant firm fixed effects in the regressions.[12]. The complete data set has a total of $9,207,498$ observations from $611,194$ firms and 44 banks, while the MBR database consists of $3,394,771$ observations from $113,548$ firms and 42 banks.

We obtain additional information on the characteristics of the loan and firm from the credit registry. We classify these characteristics into three categories:

- **Loan characteristic:** dummy variable for large loans (credits at least greater than the 85 percentile), dummy variable for fixed rate loans, and time to maturity (in quarters).

- **Bank-firm relationship characteristics:** dummy variable if the loan is a credit line, length of bank-firm relationship (in quarters), dummy variable if the loan includes collateral, number of banking relationships.

- **Firm characteristic:** size of firm (three categories: small, medium and large depending on number of employees), credit score (numeric value where the highest number indicates a better credit score).

The second data set provides banks' balance sheet information and indexes used by the regulatory institutions. This information is self-reported each month as part of mandatory filings by the CNBV and then made public. We classify bank-specific characteristics from this database into five categories:

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[10]Outliers from the credit data set are trimmed at the 1% level

[11]Commercial banks grant around 60% of all loans to the private sector in Mexico. The database only considers loans destined for business purposes, this means that household loans such as consumption credits and mortgages are not included.

[12]See Khwaja and Mian (2008))

- **Main indicators:** size (log of total assets), liquidity coverage ratio and bank capital ratio (net capital to total assets).

- **Risk profile:** share of non-performing loans to total loans and share of write-offs to total loans.

- **Revenue mix:** diversification ratio (non-interest income to total income) and share of trading assets to total assets.

- **Funding composition:** share of long-term funding, share of funding from foreign sources and share of demand deposits to total funding.

- **Profitability:** efficiency (operating cost to total income).

The last variable we consider is the Herfindahl–Hirschman Index (HHI) measure of competition in the Mexican banking system. This measure was constructed using the share of each bank's assets in the financial system.

Despite a negative skew in the distribution of credit in the MBR database (Graph 6, left panel), summary statistics of variables used in the analysis are similar across data sets (Table 1). This implies that the MBR database provides an accurate representation of the complete data and that the results obtained from the MBR database will hold in the complete database. Still, for robustness, we run all regression with the complete database to confirm this assumption. Correlations in the subsample do not indicate problems with colinearity (Table 2). There are no correlations bigger than 0.75 and the biggest is -0.71 between log(Total assets) and long term funding. The former is one the most correlated variables, which is natural given its importance.

In the second part of the paper we analyse how subsidiaries react differently to shocks compared to domestic banks. For this analysis we focus on the MBR database. The sample of loans granted by subsidiaries consists of 1,839,695 observations from 97,697 firms and 13 banks, while for domestic banks consists of 931,800 observations from 70,016 firms and 29 banks. The distribution of loans granted by subsidiaries compared to the distribution of loans granted by domestic banks is similar (Graph 6, right panel). Additionally, there are no major differences between the BSCs descriptive statistics by type of bank (Table **??**). However, there are some important differences between the characteristics of a loan granted by subsidiaries compared to a loan granted by domestic banks. Domestic banks lend more to larger firms and grant larger loans. By contrast, subsidiaries take less risk by granting loans

to high-quality firms, measured by the firm's credit score. Using Kolmogorov-Smirnov, the characteristics that are more different in the distribution of loans granted by subsidiaries and loans granted by domestic banks are credit line, fixed rate, and maturity. First, subsidiaries grant a higher proportion of credit line loans, whereas domestic banks grant approximately the same proportion of credit lines and non-credit lines. Second, subsidiaries grant more loans with fixed rates while domestic banks grant more loans with variable rates (90% of loans). Finally, while more than half the loans granted by subsidiaries have long term maturities, almost all of the loans granted by domestic banks have short term maturities.

We consider five types of shocks in the analysis. First, we evaluate the response of credit to the quarterly change in Mexico's monetary policy rate (Graph 7, panel 1). Our period of study includes both easing and tightening phases in monetary policy. Second, we study four types of external shocks: global financial risk, global liquidity, global economic policy uncertainty, and global commodity prices. These are defined by dummy variables that depend on percentile value thresholds of proxy variables that represent each shock (shaded areas in Graph 7). The global risk shock corresponds to a dummy variable that takes the value of one if the VIX index lies above its 75th percentile (Graph 7, panel 2). The global liquidity shock corresponds to a dummy variable that takes the value of one if the BIS global liquidity indicator lies above its 75th percentile (Graph 7 panel 3).[13] The global economic policy uncertainty shock corresponds to a dummy variable that takes the value of one if the Baker et al (2016) index is above its 80th percentile (Graph 7, panel 4). Finally, the global commodity price shock corresponds to a dummy variable that takes the value of one if the annual growth in commodity prices is below its 40th percentile (Graph 7, panel 5).

5   Empirical Strategy

The empirical analysis studies the determinants of the credit supply in Mexico and evaluates which characteristics amplify or dampen the effects of domestic

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[13]The BIS uses the term "global liquidity" to refer to the ease of financing in global financial markets. Their broadest category is banks' international claims. These are defined as banks' cross-border claims denominated in all currencies plus banks' local claims denominated in foreign currencies. The data covers credit to the bank and non-bank sectors worldwide and is obtained from the BIS locational banking statistics.

and external shocks. The dependent variable in all specifications is the log-change in the total amount (sum of loans) owed by firm f to bank b at time t. In the baseline specification, the explanatory variables of interest are a vector of bank specific characteristics (BSC) $X_{b,t-1}$. We include time-invariant bank fixed effects α_b. and time-variant firm fixed effects $\gamma_{f,t}$ to control for demand shifts and identify properly changes in the credit supply. We estimate the following panel equation:[14]

$$\Delta log(Credit_{f,b,t}) = \beta X_{b,t-1} + \alpha_b + \gamma_{f,t} + \varepsilon_{f,b,t} \qquad (1)$$

A drawback from the identification strategy is that it is necessary to restrict the database to consider only firms with multiple banking relationships (MBR). In section 4 we showed that the distribution of loans between the MBR database and the complete database is similar. Still, for robustness, we estimate the effect of BSCs on loan growth with the complete database controlling for demand shifters:[15]

$$\Delta log(Credit_{f,b,t}) = \beta X_{b,t-1} + \lambda Other_{f,t} + Macro_t + \alpha_{f,b} + \varepsilon_{f,b,t} \qquad (2)$$

where $Other_{f,t}$ are credit demand controls, $Macro_{i,t}$ are macroeconomic controls, and $\alpha_{f,b}$ are time-invariant bank-firm fixed effects. We include loan, bank-firm relationship, firm, and industry characteristics in the vector of demand controls. Finally, we include quarter, state and sectorial dummies.

5.1   Transmission of domestic and global shocks

We extend the baseline specification to analyse the influence of a bank's structure on the effect of domestic and global shocks on loan growth. First, we focus on the role of BSCs on the transmission of shocks to credit supply:

$$\Delta log(Credit_{f,b,t}) = (\beta + \beta^* \Delta i_{t-1}) X_{b,t-1} + \alpha_b + \gamma_{f,t} + \varepsilon_{f,b,t} \qquad (3)$$

$$\Delta log(Credit_{f,b,t}) = (\beta + \beta^* D_{i,t}) X_{b,t-1} + \alpha_b + \gamma_{f,t} + \varepsilon_{f,b,t} \qquad (4)$$

In equation 3 we evaluate the transmission of monetary policy through the bank-lending channel, where Δi_{t-1} is the quarterly change in the policy

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[14]The model is based on Ongena, Peydró and Saurina (2012) and Gambacorta and Marques-Ibanez (2011). We cluster observations by bank.

[15]Data availability precludes us from including a complete set of firm characteristics, which might affect the identification of the effects.The purpose of the exercise is to confirm that the results with the MBR database hold in the complete database.

rate. Tightening or loosening the monetary policy stance changes the risk free rate and banks' funding costs, which affects loan provision. In equation 3 we study how global shocks affect the credit supply. We characterise each of the four global shocks (high global financial uncertainty, high global liquidity, high economic policy uncertainty, low growth in commodity prices) with dummy variables ($D_{i,}$). We focus the analysis on the interaction term between BSCs and the shocks (β^*).

Next, we differentiate the behaviour of foreign subsidiaries' credit supply to that of domestic banks:

$$\Delta log(Credit_{f,b,t}) = (\beta_1 + \beta_1^* \Delta i_{t-1}) X_{b,t-1} + (\beta_2 + \beta_2^* \Delta i_{t-1}) F_b \\ + (\beta_3 + \beta_3^* \Delta i_{t-1}) X_{b,t-1} \cdot F_b + \alpha_b + \gamma_{f,t} + \varepsilon_{f,b,t} \quad (5)$$

$$\Delta log(Credit_{f,b,t}) = (\beta_1 + \beta_1^* D_{i,t}) X_{b,t-1} + (\beta_2 + \beta_2^* D_{i,t}) F_b \\ + (\beta_3 + \beta_3^* D_{i,t}) X_{b,t-1} \cdot F_b + \alpha_b + \gamma_{f,t} + \varepsilon_{f,b,t} \quad (6)$$

We include a dummy variable (F_b) for banks that are foreign subsidiaries and explore whether they react differently to shocks (β_2^*). Additionally, we analyse if there is a difference in the role of BSCs of subsidiaries in the transmission of shocks (β_3^*).

Finally, we study how loan, bank-firm relationship, firm, and industry characteristics can strengthen or weaken the effect of shocks on credit supply:[16]

$$\Delta log(Credit_{f,b,t}) = \delta \cdot \Delta i_{t-1} + (\beta + \beta^* \Delta i_{t-1}) X_{b,t-1} \\ + (\lambda + \lambda^* \Delta i_{t-1}) Other_{f,t} + Macro_t + \alpha_{f,b} + \varepsilon_{f,b,t} \quad (7)$$

$$\Delta log(Credit_{f,b,t}) = \delta \cdot D_{i,t} + (\beta + \beta^* D_{i,t}) X_{b,t-1} \\ + (\lambda + \lambda^* D_{i,t}) Other_{f,t} + Macro_t + \alpha_{f,b} + \varepsilon_{f,b,t} \quad (8)$$

We study the role of different characteristics in the transmission of shocks (λ^*) and the direct effect of shocks on credit supply (δ).

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[16]We conduct this analysis with the complete database given that the micro characteristics would get absorbed by the firm*time fixed effects in the specification with the MBR database.

6 Results

6.1 Baseline results

Table 4 presents the results of the baseline specification (equation 1). We estimate a regression for each individual block of bank-specific characteristics (columns (1)-(5)). Then, we estimate a regression that includes all variables that were statistically significant in the results from their individual block (column (6)). We follow the same strategy for all the equations in the empirical analysis.[17]

Banks with strong balance sheets supply more credit in Mexico.[18] First, within banks, those that are large and well-capitalised grant more credit, whereas those that have a higher share of non-performing loans and write-offs grant less credit. The estimated coefficient implies that a 1-percentage point increase in the bank capital ratio increases the growth in bank credit around 0.14 percentage points. This result is importance since one of the main objectives of post-crisis regulation has been to strengthen banks' capital position. One concern has been that higher capital requirements might restrain loan growth, but this result shows that a larger capital base can reduce financing constraints for banks allowing them to grant more credit.[19]

Second, we obtain a negative relationship between the growth of credit in Mexico and diversification of bank's activities and income sources. This implies that banks with a commercial business model (lower non-interest income to total income and lower trading assets as a share of total assets) grant more credit compared to universal business model banks. Finally, we find that banks with a higher share of long-term funding and lower share of funding from foreign sources grant more credit. These last results imply that the composition of banks' liabilities in terms of source type and maturity affects the credit supply. Particularly, a higher share of stable sources of funding can

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[17]The main indicator variables (size, liquidity and capital) are always included in the last regression given their importance in the bank lending literature (Gambacorta (2005).

[18]The only counter-intuitive result is the negative sign of the liquidity coverage ratio. One reason can be that small banks faced challenges in 2015 as they complied with the phase-in requirements of the Basel III liquidity coverage ratio. These banks increased their liquidity coverage ratio while granting less loans as they turned to long-term sources of funding and adjusted the maturity of their balance sheets.

[19]Other studies find a similar effect. For example, Gambacorta and Shin (2018) find that a 1-percentage point increase in the equity-to-assets ratio increases total lending growth by 0.6 percentage points.

foster banks' loan growth.

For robustness, we obtain the estimates of the effect of BSCs on loan growth with the complete database, controlling for other loan demand shifters (equation 2). We confirm that both the sign and significance of the coefficients remain the same with the exception of the coefficient of the LCR (Table 4, column (7)). We postpone the discussion on the influence of other micro characteristics on credit supply for a later section.

6.2 How do banks with different characteristics react to shocks?

Table 5 reports the coefficients of the interaction term between BSCs and the five shocks shocks (one domestic monetary policy shock and four external global shocks (equation 3 and equation 4)). For the monetary policy shock, the results are the following (Column (1)). First, strongly capitalised and highly liquid banks adjust less their credit supply when faced with a monetary policy shock. Second, banks with high risk indicators (non-performing loans and write-offs), high share of trading assets to total assets and high share of funding from foreign sources are more affected by monetary policy shocks. Finally, highly-profitable banks that rely more on deposits are less apt to reduce their credit supply during a monetary tightening. Deposits, like demand and savings deposits, are largely inelastic and have historically insulated bank funding costs against economic shocks by smoothing borrowing costs (Berlin and Mester (1999)). All together, the results imply that BSCs that reduce banks' constraints to raise funds from stable sources weaken the transmission channel of monetary policy. Our findings are consistent with the literature on the bank-lending channel (Altunbas et al (2012), Kishan and Opiela (2000), and Altunbas et al (2010)).

Next, we analyse how banks with different characteristics react to external shocks. First, we consider global risk (high VIX index (column (2))). Strongly capitalised and highly-liquid banks are less apt to reduce credit supply during periods of high global financial risk. These results are well documented in the literature (Kapan and Minoui (2013)) and stress the importance of liquidity and capital as buffers that mitigate the effects of risk shocks. Banks with a higher diversification ratio (non-interest income) are more affected by global risk shocks, while banks with a higher share of trading assets are less affected by these shocks. This implies that universal business model banks are more

affected by high global risk, but a higher share of trading assets dampens the effect. Finally, as in the baseline, banks with a higher share of long-term funding and lower share of funding from foreign sources react less sensitively to global risk shock.

The second shock corresponds to high global liquidity conditions (Column (3)). In the aftermath of the GFC, permissive credit conditions in advanced economies eased liquidity constraints in emerging markets (BIS (2011)). While liquidity shortages can have important implications for stability and growth, global liquidity excesses can contribute to the endogenous build-up of vulnerabilities (Caruana (2014)). Highly-liquid banks with low risk indicators expand more their credit supply during high liquidity periods. By contrast, banks with a higher share of trading assets take less advantage of the easing in liquidity conditions and increase their credit supply to a lesser extent. Finally, banks that draw on stable sources of funding (higher share of deposits and long-term funding) are more apt to increase their credit supply when global liquidity is high.[20] Together, these results imply that banks which supply more credit during high liquidity periods have characteristics that help them address any potential build-up of vulnerabilities (high liquidity, low risk, and stable sources funding).

The third shock corresponds to periods of high economic policy uncertainty (Column (3)). High economic uncertainty is associated with greater stock price volatility in international markets and reduced business investment in policy-sensitive sectors. Generously capitalised banks that rely more on deposits are less affected by economic policy uncertainty shocks. By contrast, banks with a higher diversification ratio and a greater share of funding from foreign sources are more affected by these shocks. Then, commercial business model banks with a deposit-based funding structure can sustain credit growth when faced by shocks that curtail investment opportunities.

The last shock corresponds to periods of low growth in global commodity prices (Column (4)). Commodity prices can affect bank lending through the credit supply channel driven by the nominal exchange rate and export revenues (Kohlscheen, Avalos and Schrimpf (2016) and Agarwal et al (2018)). Highly-liquid and profitable banks with stable sources of funding (long-term funding and deposits) react less sensitively to commodity price shocks. By

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[20]We consider deposits as a stable source of funding since historically they have been the main source of funding for banks.

contrast, banks with a universal business model, high risk indicators and high dependence on funding from foreign sources are more vulnerable against these shocks. Currency mismatches in banks' balance sheets can further amplify the negative effect of commodity price shocks.

A common result in all specifications is that Mexican banks that draw on funding from foreign sources are more apt to reduce their credit supply when hit by shocks. In the aftermath of the GFC there has been a shift in the drivers of international bank lending (Avdjiev et al (2017)). International banks flows have become more responsive to the degree of commonality of financial cycles and the stance of policy in advanced economies. Then, banks that rely on funding from foreign sources are increasingly susceptible to changes in global financial and economic conditions. On the upside, regulation that prevents currency mismatches in banks' balance sheets and the increase in banks' hedging against their foreign currency positions mitigates this vulnerability.

6.3 How do foreign subsidiaries respond differently to shocks?

There is a strong presence of foreign subsidiaries in Mexico. They are formally independent legal entities, but they follow the guidelines of the parent bank. Moreover, there is strict regulation and supervision that covers changes in risk exposures and limits on internal transfers of capital and liquidity between headquarters and subsidiaries. The number of subsidiaries increased after all restrictions on foreign investment in banks were lifted in 1998. In 2017, from a total of 48 banks operating in Mexico 19 are foreign subsidiaries and from the 7 largest banks 5 are subsidiaries. Additionally, foreign subsidiaries hold 65% of the share of total banks' assets in the system. We find that foreign subsidiaries are more affected by shocks and that some BSCs influence differently the transmission of shocks for subsidiaries than for domestic banks.

Table 6 reports the results of estimation that includes the foreign subsidiary dummy (equation 5 and equation 6). We find that the interaction term of the subsidiary dummy with each shock is negative and statistically significant[21]. This implies that foreign subsidiaries' credit supply reacts more sensitively to domestic monetary policy and external shocks. One explanation for this

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[21]For the global liquidity shock the interaction term is positive and statistically significant, which means that foreign subsidiaries adjust more their credit supply when faced by this shock.

behaviour is that international banks usually assess risk across their whole institution. Then, a negative shock can have a greater effect on subsidiaries as headquarters adjusts their risk-taking globally (Alcaraz et al (2018)).

The results from the double interaction (shock*BSC) are consistent with those obtained in Table 5 and with the analysis presented in the previous section. There are two set of results from the coefficients of the triple interaction (shock*subsidiary*BSC). BSCs associated with strong bank balance sheets influence the transmission of shocks in the same manner for subsidiaries as for domestic banks. In general, large, highly-liquid, strongly-capitalised domestic banks and subsidiaries with a higher share of long-term funding are more sheltered against shocks. By contrast, domestic banks and subsidiaries with high risk indicators and high share of trading assets are more vulnerable against shocks.

Next, there are some bank characteristics that, while for domestic banks strengthen/weaken the transmission of shocks, they have the opposite effect for subsidiaries. First, in general, subsidiaries with a higher diversification ratio (universal business model) and that draw more on funding from foreign sources are less affected by shocks. These two characteristics were generally associated with higher vulnerabilities for domestic banks. A higher share of funding from foreign sources constitutes a greater risk for domestic banks as it can lead to currency mismatches in their balance sheets. By contrast, subsidiaries are allowed to receive contributions from their parent bank, which would lead to a higher share of funding from foreign sources. This extra line of credit can help subsidiaries when funding becomes scarce due to shocks. Second, in general, subsidiaries with a higher share of deposits are more affected by shocks while for domestic banks the result is the opposite. During periods of high stress foreign subsidiaries attract less domestic deposits and higher funding from foreign sources. The difference between the flow of funds compared to domestic banks is due to the ability of complex banks to reallocate liquidity across the different jurisdictions in which they operate (Cetorelli and Goldberg (2012)).

6.4 How do other micro characteristics affect the transmission of shocks?

The last part of our analysis takes advantage of the additional information contained in the credit registry to evaluate how other characteristics (loan,

bank-firm relationship, firm and industry) influence the supply of credit in Mexico. For this analysis we use the complete database and control for a series of demand shifters and seasonal/state/sector effects.

First, we corroborate that the effects of shocks on credit supply are consistent (Table 7). Monetary policy, global risk, economic policy uncertainty and commodity price shocks have a negative effect on the supply of credit, while global liquidity shocks have a positive effect. Then, we divide our findings on the effects of other characteristics into two sets. The first set corresponds to those characteristics that have a positive relationship with credit growth during normal times and when the economy is hit by shocks. The second set corresponds to those characteristics that have a positive/negative relationship with credit growth during normal times but the opposite relationship with credit growth when the economy is hit by shocks.

Within our first set, there is a positive relationship between credit growth and if the loan is a credit line and includes collateral. Moreover, credit growth is higher for firms with longer relationships with banks and higher credit scores. The positive relationships are maintained during shock periods. One additional result during periods of stress is that credit growth for larger firms reacts less sensitively than for smaller firms.

Within our second set, there is a positive relationship between credit growth and if the loan is large, has a fixed rate, and long maturity. By contrast, during shock periods, there is generally a negative relationship between credit growth and these loan characteristics. One explanation is that banks become more risk adverse during stress periods and prefer to grant loans with safer characteristics. For example, Black and Rosen (2016) show that in response to a monetary tightening, banks reduce the average maturity of their loan supply, which effectively reduces the loan supply over time. Turning to bank-relationship characteristics, credit growth is negatively related to the number of banking relationships, but credit growth to firms with more banking relationships is less affected during shock periods. Finally, there is an negative relationship between credit growth and less competition in the banking sector (higher Herfindahl index), but less competition shelters the banking industry from shocks. This last result is particularly relevant since the banking sector in Mexico is highly concentrated and not very competitive.

7 Conclusions

After the GFC, a renewed effort has been made to implement regulatory reforms aimed at safeguarding financial stability and strengthening bank balance sheets. The aim is to make banks more resilient and to reduce the transmission of negative shocks to the real economy via the credit channel. This paper explores the determinants of the credit supply in Mexico, taking advantage of the granularity provided by credit registry data.

First, we find that banks with stronger balance sheets (large and well-capitalised) and with stable sources of funding (higher long-term and lower funding from foreign sources) supply more credit. Additionally, banks with higher risk indicators (non-performing loans and write-offs) and with a universal business model (those that rely on non-interest income and have a higher share of trading assets) grant less credit. Second, we show that the importance of bank characteristics in the transmission of shocks depends on the type of shock. In general, strong balance sheets, stable funding, and high profitability weaken the transmission of shocks. On the contrary, higher bank-risk indicators, a universal business model, and greater dependence on funding from foreign sources strengthen the transmission of shocks. Third, foreign subsidiaries in Mexico contract their credit supply more actively than domestic banks do when a shock hits the economy. In contrast to domestic banks, foreign subsidiaries with a universal business model, a higher share of funding from foreign sources, and a lower share of deposits are more sheltered against shocks. Fourth, there is a positive relationship between loan growth and high-quality creditors with strong banking relationships. Additionally, the loan supply to these creditors is less affected by shocks. Finally, weak competition in the banking industry has a negative relationship with loan growth but helps shield the system against shocks.

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Appendix A Tables and Graphs

Table 1: Descriptive Statistics by database

CD	Mean	Std. Dev.	Min.	Median	Max.
Δ log(Credit)	-0.046	0.867	-23.786	-0.076	20.565
log(Assets)	13.386	1.034	5.929	13.780	14.187
LCR	2.430	1.256	0.000	2.286	7.000
Capital	0.117	0.026	0.026	0.111	0.886
NPL	0.028	0.016	0.000	0.025	0.493
Write-offs	0.003	0.002	0.000	0.003	0.104
Diversification	0.162	0.197	-10.734	0.172	1.459
Trading assets	0.024	0.028	-0.898	0.021	0.869
LT funding	0.198	0.110	0.000	0.169	0.969
Fund foreign	0.076	0.026	0.000	0.076	0.655
Deposits	0.368	0.085	0.000	0.386	0.941
Efficiency	64.400	29.598	-1212.251	58.940	14904.305
Large loan	0.150	0.357	0.000	0.000	1.000
Fixed rate	0.359	0.480	0.000	0.000	1.000
Maturity	53.423	46.116	0.000	35.000	100.000
Credit line	0.696	0.460	0.000	1.000	1.000
Time with bank	11.056	8.606	0.000	9.000	34.000
Collateral	0.105	0.307	0.000	0.000	1.000
Banking relationships	1.449	0.909	1.000	1.000	16.000
Firm size	2.124	0.384	2.000	2.000	4.000
Credit score	2.886	3.506	0.000	0.000	8.000
HHI	1264.912	68.943	1165.820	1272.240	1471.830

MBR	Mean	Std. Dev.	Min.	Median	Max.
Δ log(Credit)	-0.046	0.773	-18.444	-0.075	18.185
log(Assets)	13.183	1.044	6.202	13.555	14.187
LCR	2.244	1.352	0.000	2.047	7.000
Capital	0.112	0.029	0.026	0.107	0.886
NPL	0.026	0.013	0.000	0.024	0.493
Write-offs	0.003	0.002	0.000	0.003	0.104
Diversification	0.154	0.236	-10.734	0.172	1.459
Trading Assets	0.023	0.031	-0.716	0.017	0.869
LT Funding	0.220	0.116	0.000	0.199	0.969
Fund foreign	0.074	0.028	0.000	0.076	0.655
Deposits	0.349	0.089	0.000	0.358	0.941
Efficiency	65.064	30.643	-1212.251	60.009	14904.305

Table 2: Correlations

	Δ log(Credit)	log(Assets)	LCR	Capital	NPL	Write-offs	Div. ratio	Trading assets	LT funding	Fund foreign	Deposits	Efficiency
Δ log(Credit)	1.000											
log(Assets)	0.018	1.000										
LCR	0.009	0.376	1.000									
Capital	-0.010	0.088	0.073	1.000								
NPL	-0.008	-0.097	0.290	0.199	1.000							
Write-offs	0.015	0.441	0.444	0.014	0.062	1.000						
Diversification	0.009	0.128	0.129	-0.206	0.050	0.172	1.000					
Trading assets	-0.012	-0.153	-0.063	0.324	-0.069	0.017	-0.118	1.000				
LT funding	-0.015	-0.704	-0.382	-0.041	0.057	-0.433	-0.031	0.007	1.000			
Fund foreign	0.011	0.454	0.181	-0.105	-0.165	0.212	0.087	-0.100	-0.240	1.000		
Deposits	0.009	0.685	0.328	0.176	-0.059	0.349	0.077	0.002	-0.520	0.584	1.000	
Efficiency	0.002	-0.194	0.224	-0.187	0.152	0.093	0.072	-0.071	0.075	-0.037	-0.065	1.000

Table 3: Descriptive statistics by bank type

Domestic	Mean	Std. Dev.	Min.	Median	Max.
Δ log(Credit)	-0.076	0.724	-16.900	-0.075	15.597
log(Assets)	12.226	1.256	6.202	12.271	13.600
LCR	1.112	0.708	0.000	1.051	4.000
Capital	0.108	0.044	0.026	0.094	0.606
NPL	0.025	0.017	0.000	0.022	0.493
Write-offs	0.001	0.001	0.000	0.001	0.104
Diversification	0.085	0.398	-3.932	0.124	0.882
Trading Assets	0.025	0.045	-0.529	0.008	0.732
LT Funding	0.322	0.142	0.000	0.270	0.969
Fund Foreign	0.056	0.032	0.000	0.054	0.568
Deposits	0.285	0.092	0.000	0.297	0.941
Efficiency	64.222	23.861	-95.397	62.687	1191.256

Subsidiary	Mean	Std. Dev.	Min.	Median	Max.
Δ log(Credit)	-0.031	0.792	-18.444	-0.075	18.185
log(Assets)	13.655	0.417	6.251	13.757	14.187
LCR	2.803	1.240	0.797	2.434	7.000
Capital	0.115	0.016	0.055	0.110	0.886
NPL	0.027	0.010	0.000	0.025	0.189
Write-offs	0.003	0.001	0.000	0.003	0.009
Diversification	0.188	0.041	-10.734	0.184	1.459
Trading Assets	0.022	0.021	-0.716	0.021	0.869
LT Funding	0.170	0.051	0.000	0.164	0.855
Fund Foreign	0.083	0.020	0.000	0.080	0.655
Deposits	0.381	0.067	0.000	0.385	0.722
Efficiency	65.479	33.479	-1212.251	58.364	14904.305

Table 4: How bank-specific characteristics determine the credit supply.

Δ log(Credit)	(1) Main	(2) Risk	(3) Revenue	(4) Funding	(5) Profit	(6) All	(7) All (CD)
log(Assets)	0.00860*					0.00862*	0.0621***
	(0.00514)					(0.00517)	(0.00328)
LCR	-0.00533***					-0.00365***	0.00194***
	(0.000983)					(0.00102)	(0.000456)
Capital	0.0394					0.140***	0.201***
	(0.0476)					(0.0498)	(0.0278)
NPL		-0.619***				-0.647***	-0.343***
		(0.0720)				(0.0747)	(0.0328)
Write-offs		-0.141***				-0.0900**	-0.352***
		(0.0435)				(0.0446)	(0.0181)
Diversification			-0.00631***			-0.00793***	-0.00424***
			(0.00220)			(0.00226)	(0.000696)
Trading Assets			-0.0903***			-0.0821***	-0.242***
			(0.0228)			(0.0233)	(0.0125)
LT Funding				0.0606***		0.0463***	0.189***
				(0.0113)		(0.0113)	(0.00636)
Fund Foreign				-0.170***		-0.158***	-0.205***
				(0.0405)		(0.0396)	(0.0198)
Deposits				-0.0133			
				(0.0160)			
Efficiency					-0.00653		
					(0.0174)		
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No
Firm*time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No
Bank-firm fixed effects	No	No	No	No	No	No	Yes
Firm/Relation charact	No	No	No	No	No	No	Yes
Macro controls	No	No	No	No	No	No	Yes
Quarterly dummies	No	No	No	No	No	No	Yes
State/Sector dummies	No	No	No	No	No	No	Yes
Sample	MBR	MBR	MBR	MBR	MBR	MBR	CD
Number of debtors	112,905	112,905	112,905	112,905	112,905	112,905	788,486
Number of banks	42	42	42	42	42	42	42
Observations	2,661,252	2,663,343	2,663,343	2,663,343	2,662,121	2,661,252	9,285,535
R^2	0.440	0.440	0.440	0.440	0.440	0.440	0.022

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: How banks with different characteristics respond to shocks.

Δ log(Credit) Shock*	(1) Monetary Policy	(2) Global Risk	(3) Global Liq	(4) Economic Policy	(5) Commodity P
log(Assets)	-0.00777***	-0.000240	-0.00113	-0.00181	0.00175
	(0.00249)	(0.00241)	(0.00215)	(0.00170)	(0.00248)
LCR	0.0199***	0.00541***	0.0105***	-0.00109	0.00874***
	(0.00211)	(0.00129)	(0.00157)	(0.00109)	(0.00132)
Capital	0.286***	0.251***	0.0691	0.227***	0.0674
	(0.0943)	(0.0576)	(0.0579)	(0.0571)	(0.0596)
NPL	-1.153***	-0.201	-0.724***		-0.0590
	(0.180)	(0.152)	(0.135)		(0.135)
Write-offs	-0.798***	-0.110	-0.575***		-0.443***
	(0.145)	(0.101)	(0.107)		(0.0976)
Diversification	-0.0125	-0.0137***		-0.0101**	-0.0236*
	(0.0269)	(0.00480)		(0.00500)	(0.0142)
Trading Assets	-0.186***	0.0999*	-0.136***		-0.0752*
	(0.0590)	(0.0513)	(0.0489)		(0.0449)
LT Funding		0.0788***	0.0361*		0.0929***
		(0.0193)	(0.0190)		(0.0177)
Fund Foreign	-0.560***	-0.385***		-0.219***	-0.519***
	(0.0861)	(0.0849)		(0.0646)	(0.0673)
Deposits	0.165***	0.0198	0.108***	0.0932***	0.112***
	(0.0273)	(0.0281)	(0.0328)	(0.0215)	(0.0235)
Efficiency	0.126**				0.205**
	(0.0545)				(0.0819)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes
Firm*time fixed effects	Yes	Yes	Yes	Yes	Yes
Bank-firm fixed effects	No	No	No	No	No
Firm/Relation charact	No	No	No	No	No
Macro controls	No	No	No	No	No
Quarterly dummies	No	No	No	No	No
State/Sector dummies	No	No	No	No	No
Sample	MBR	MBR	MBR	MBR	MBR
Number of debtors	112,905	112,905	112,905	112,905	112,905
Number of banks	42	42	42	42	42
Observations	2,660,827	2,640,338	2,636,650	2,640,338	2,639,914
R^2	0.440	0.492	0.492	0.492	0.492

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: How foreign subsidiaries respond differently to shocks.

Δ log(Credit)	(1) Monetary Policy	(2) Global Risk	(3) Global Liq	(4) Economic Policy	(5) Commodity P
Shock*Subsidiary	-0.618***	-0.323***	-0.263***	-0.0199	-0.743***
	(0.119)	(0.123)	(0.0994)	(0.0697)	(0.128)
Shock*					
log(Assets)	0.00252	-0.00768**	-0.00811***	0.000697	-0.000967
	(0.00543)	(0.00350)	(0.00304)	(0.00302)	(0.00326)
LCR	0.0107	0.0109**	0.0211***	0.0162***	-0.00335
	(0.00797)	(0.00467)	(0.00539)	(0.00432)	(0.00419)
Capital	0.212*	0.279***	0.152**	0.0319	0.00850
	(0.113)	(0.0656)	(0.0632)	(0.0595)	(0.0589)
NPL	-1.348***	-0.111	-0.253*		-0.144
	(0.231)	(0.205)	(0.143)		(0.154)
Write-offs	-0.340	-0.0785	-0.975***		-0.425***
	(0.270)	(0.146)	(0.171)		(0.136)
Diversification	-0.0136	-0.00508		-0.00975*	-0.0312*
	(0.0296)	(0.00499)		(0.00512)	(0.0178)
Trading Assets	-0.0155	-0.0164	-0.136***		-0.0767
	(0.0736)	(0.0636)	(0.0489)		(0.0482)
LT Funding		0.0538**	0.0361*		0.0266
		(0.0226)	(0.0190)		(0.0184)
Fund Foreign	-0.419***	-0.236**		-0.218**	-0.764***
	(0.127)	(0.112)		(0.0870)	(0.0820)
Deposits	0.158***	0.0311	0.108***	0.0176	0.139***
	(0.0532)	(0.0371)	(0.0328)	(0.0327)	(0.0324)
Efficiency	1.332***				0.0589
	(0.239)				(0.101)
Shock*Subsidiary*					
log(Assets)	0.0317***	0.0225**	0.0246***	0.00797	0.0411***
	(0.00888)	(0.00880)	(0.00730)	(0.00563)	(0.00886)
LCR	0.0186**	0.000373	0.00159	0.0148***	0.0180***
	(0.00850)	(0.00497)	(0.00561)	(0.00455)	(0.00465)
Capital	1.147***	0.472***	0.116	0.564***	1.030***
	(0.278)	(0.135)	(0.152)	(0.130)	(0.159)
NPL	-0.209	-0.819***	-2.357***		-1.192***
	(0.504)	(0.315)	(0.308)		(0.296)
Write-offs	-0.982***	-0.0274	-0.461*		-0.409**
	(0.365)	(0.198)	(0.240)		(0.183)
Diversification	0.226**	0.157***		0.144**	0.0351
	(0.113)	(0.0323)		(0.0631)	(0.0433)
Trading Assets	-0.791***	-0.387***	-0.362***		-0.0509
	(0.175)	(0.115)	(0.102)		(0.103)
LT Funding		0.135*	0.144***		0.0599
		(0.0781)	(0.0537)		(0.0642)
Fund Foreign	1.044***	0.224***		0.135***	1.301***
	(0.234)	(0.0182)		(0.0140)	(0.135)
Deposits	-0.192***	-0.168***	-0.156***	-0.112***	-0.364***
	(0.0705)	(0.0565)	(0.0400)	(0.0419)	(0.0472)
Efficiency	0.174				0.833***
	(0.288)				(0.198)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes
Firm*time fixed effects	Yes	Yes	Yes	Yes	Yes
Bank-firm fixed effects	No	No	No	No	No
Firm/Relation charact	No	No	No	No	No
Macro controls	No	No27	No	No	No
Quarterly dummies	No	No	No	No	No
State/Sector dummies	No	No	No	No	No
Sample	MBR	MBR	MBR	MBR	MBR
Number of debtors	112,905	112,905	112,905	112,905	112,905
Number of banks	42	42	42	42	42
Observations	2,657,093	2,657,518	2,657,518	2,657,518	2,657,093
R^2	0.440	0.440	0.440	0.440	0.441

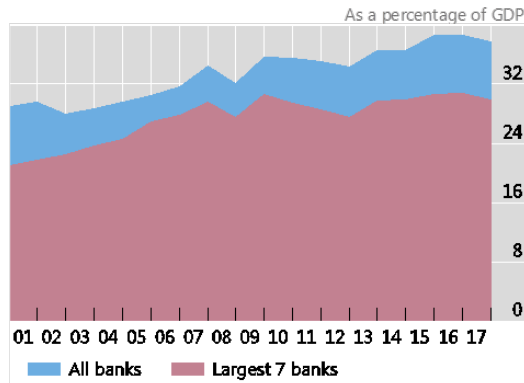Table 7: How other characteristics affect the response to shocks.

	(1)	(2)	(3)	(4)	(5)	(6)
Δ log(Credit)	Baseline	Monetary Policy	Global Risk	Global Liq	Economic Policy	Commodity P
Shock		-1.257***	-0.261***	0.0635***	-0.582***	-0.503***
		(0.0449)	(0.0259)	(0.0206)	(0.0386)	(0.0225)
Shock*						
Large loan	0.414***	-0.0192***	0.000276	-0.00980***	0.000636	-0.0285***
	(0.00155)	(0.00203)	(0.00165)	(0.00137)	(0.00141)	(0.00137)
Fixed rate	0.0147***	-0.00768***	0.00735***	-0.00609***	0.0109***	-0.00759***
	(0.00118)	(0.00197)	(0.00157)	(0.00126)	(0.00133)	(0.00127)
Maturity	0.110***	-0.0318***	-0.0156***	-0.0144***	-0.0107***	-0.0193***
	(0.0154)	(0.0273)	(0.0204)	(0.0174)	(0.0175)	(0.0171)
Credit line	0.0622***	0.0336***	0.00869***	0.0225***	0.0143***	0.000733
	(0.00126)	(0.00240)	(0.00163)	(0.00145)	(0.00150)	(0.00143)
Time with bank	0.0136***	0.00371***	0.00231***	0.00174***	0.00166***	0.00357***
	(0.000138)	(0.000104)	(0.000136)	(7.40e-05)	(7.38e-05)	(7.77e-05)
Collateral	0.0151***	0.0445***	0.0275***	0.00629***	0.0227***	0.0282***
	(0.00110)	(0.00247)	(0.00169)	(0.00163)	(0.00169)	(0.00161)
Banking relationships	-0.0111***	0.000171	0.00238***	-0.00342***	0.000962*	0.00308***
	(0.000575)	(0.000794)	(0.000614)	(0.000525)	(0.000546)	(0.000505)
Firm Size	0.0389	0.0182***	0.0171***	0.00374***	0.00617***	0.00874***
	(0.0283)	(0.00210)	(0.00146)	(0.00133)	(0.00141)	(0.00125)
Credit score	0.0175***	0.0132***	0.00199***	0.000428*	0.00839***	0.00743***
	(0.000132)	(0.000320)	(0.000276)	(0.000226)	(0.000234)	(0.000244)
HHI	-0.131***	0.834***	0.166***	0.0677***	0.498***	0.312***
	(0.0139)	(0.0343)	(0.0173)	(0.0136)	(0.0316)	(0.0151)
Constant	-1.245***	-1.959***	-1.726***	-1.787***	-1.700***	-1.276***
	(0.101)	(0.105)	(0.104)	(0.104)	(0.103)	(0.105)
Bank fixed effects	No	No	No	No	No	No
Firm*time fixed effects	No	No	No	No	No	No
Bank-firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm/Relation charact	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarterly dummies	Yes	Yes	Yes	Yes	Yes	Yes
State/Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sample	CD	CD	CD	CD	CD	CD
Number of debtors	788,486	788,475	788,486	787,959	788,486	788,475
Number of banks	42	42	42	42	42	42
Observations	9,285,535	9,285,100	9,285,535	9,281,144	9,285,535	9,285,100
R^2	0.022	0.023	0.022	0.022	0.022	0.023

Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Mexican Banking System

Graph 1

Deposit money bank assets

As a percentage of GDP

01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17

■ All banks ■ Largest 7 banks

Bank's assets by parent nationality

Per cent

00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17

■ Mexico ■ Spain ■ United States
■ Canada ■ United Kingdom ■ Other
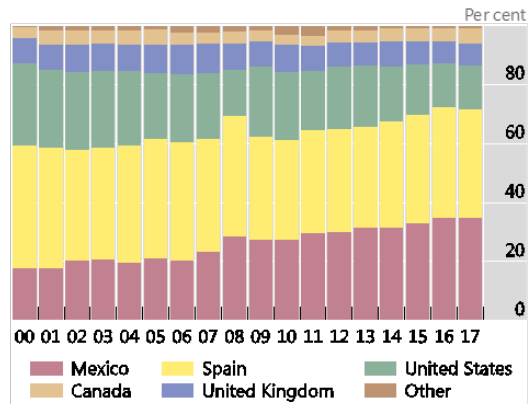
Source: CNBV.

Evolution of banks and credit in Mexico

Graph 2

Banks by parent nationality

Number of banks

82 83 85 90 94 98 03 05 08 12 17

■ Domestic ■ Foreign

Credit by sector

As a percentage of GDP

1982 1987 1992 1997 2002 2007 2012 2017

— Total[1] ■ Firms ■ Consumer ■ Housing
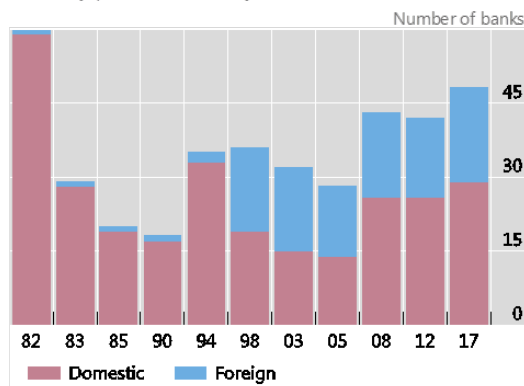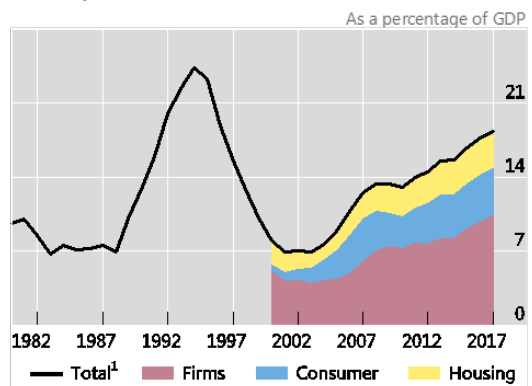
[1] CNBV starting in 2001, previous data extrapolated from BIS statistics bank credit to the private non-financial sector.

Source: Graf (1999), Herández-Murillo (2007), CNBV and BIS Statistics

Capitalisation and Risk

Graph 3

Capital ratio

% Risk weighted assets

04 05 06 07 08 09 10 11 12 13 14 15 16 17

■ Tier 1   ■ Tier 2

Non-performing loans and write offs

% Total loans

05 06 07 08 09 10 11 12 13 14 15 16 17
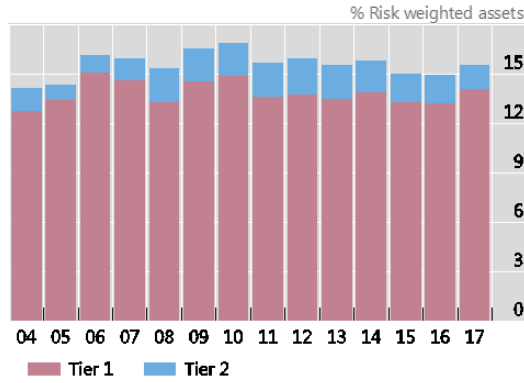
— Non–performing loans   — Write–offs
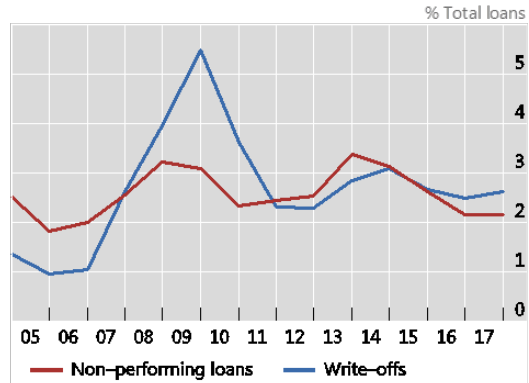
Source: CNBV.

Funding Structure

Graph 4

Type of liabilities

% Total liabilities

05 06 07 08 09 10 11 12 13 14 15 16 17

■ Demand deposits   ■ Interbank lending
■ Time deposits   ■ Operations with securities
■ Bonds   and derivatives

Assets and liabilities in foreign currency

Billions USD

2014   2015   2016   2017

■ Net synthetic assets and liabilities[1]
■ Derivatives with non financial companies
■ Hedge funds
■ Core funding
■ Portfolio and other assets
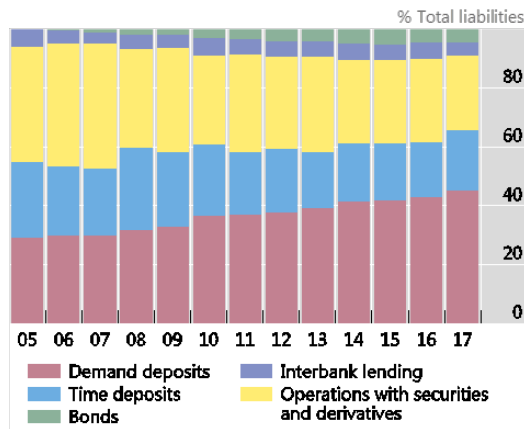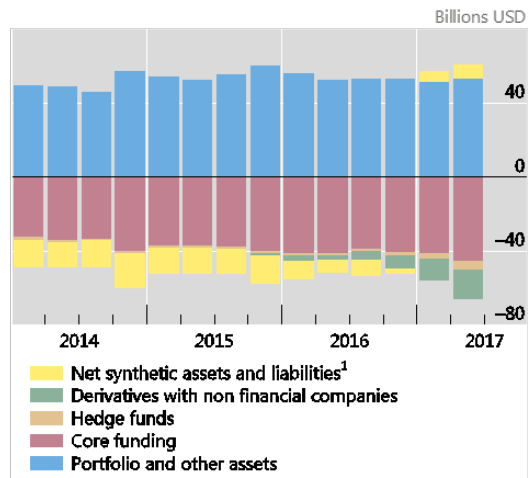
1 Net positions on foreign exchange derivatives (futures, forwards, swaps and options) whether the banks have a net asset or a liability in foreign currency.

Source: CNBV.

30

Classification of Banks' Business Models in Mexico

Number of banks; percent of total assets in parenthesis   Graph 5

Transition across models[1]

	2005	2007	2013	2017

- Trading   - Universal   - Commercial
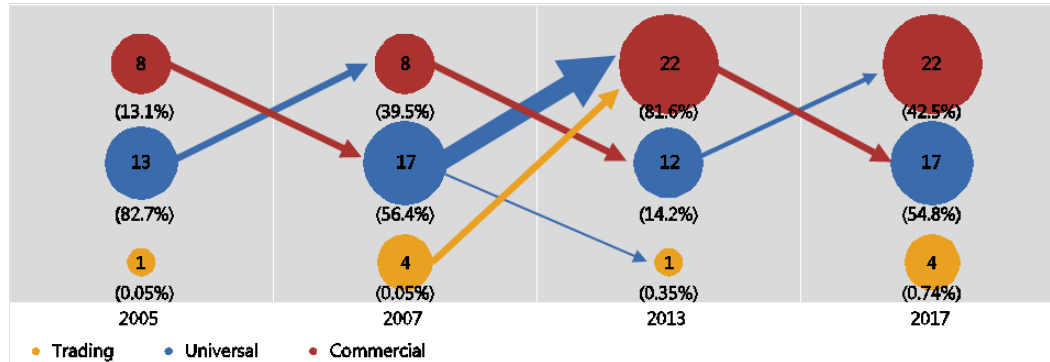
[1] Percentages do not add up to 100% since there are banks without classification.

Source: CNBV: Author's calculations.

Density of Log(Credit)   Graph 6

By data set   By type of bank
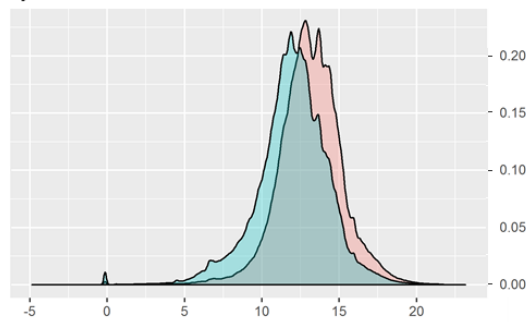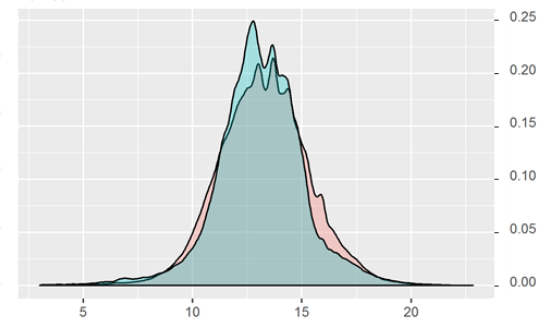
Data set: MBR   CD   Bank type: Domestic   Subsidiary

Source: CNBV.

Domestic and External Shocks

Graph 7

Monetary Policy

Basis points

2010	2012	2014	2016

— Monetary policy rate

Risk Shock

2009=100

2010	2012	2014	2016

— VIX index   ▧ High financial risk

Global liquidity

USD qdn

2010	2012	2014	2016

— Globlal liquidity
▧ High global liquidity

Economic Policy Uncertainty

2009=100

2010	2012	2014	2016

— Economic Policy Uncertainty Index
▧ High economic policy uncertainty

Commodity Prices

In per cent

2010	2012	2014	2016

— Annual growth in commodity price index
▧ Low growth in commodity prices

Source: Bank of Mexico, BIS Statistics, Wu and Xia (2016), Baker et al (2016) and Bloomberg,

Previous volumes in this series

All volumes are available on our website www.bis.org.