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The International Bank Lending Channel of Monetary Policy Rates and QE: Credit Supply, Reach-for-Yield, and Real Effects

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ABSTRACT

We identify the international credit channel by exploiting Mexican supervisory data sets and foreign monetary policy shocks in a country with a large presence of European and U.S. banks. A softening of foreign monetary policy expands credit supply of foreign banks (e.g., U.K. policy affects credit supply in Mexico via U.K. banks), inducing strong firm-level real effects. Results support an international risk-taking channel and spillovers of core countries' monetary policies to emerging markets, both in the foreign monetary softening part (with higher credit and liquidity risk-taking by foreign banks) and in the tightening part (with negative local firm-level real effects).

THE RECENT GLOBAL FINANCIAL CRISIS, as well as other previous crises, have shown that bank credit cycles have a significant effect on the economy, financial globalization can impact financial stability, and monetary policy may be a key public policy tool (Bernanke (1983), Reinhart and Rogoff (2009), Schularick and Taylor (2012)). Strong bank credit growth, especially that financed by foreign liabilities, is the most important predictor of financial crises (Jorda, Schularick, and Taylor (2011), Gourinchas and Obstfeld

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(2012)), which are in general accompanied by bank credit crunches and sudden stops of foreign capital (Bernanke and Lown (1991), Calvo and Reinhart (2000)). Moreover, as Rey (2013) argued at the Federal Reserve's annual conference in Jackson Hole, monetary policy set by the Federal Reserve may have substantial spillovers in emerging markets' credit cycles, generating an international risk-taking channel of monetary policy. In line with this view, the Federal Reserve Vice Chairman Stanley Fischer (2014), warned about international spillovers that both interest rate and quantitative easing (QE) may have, pointing out that European monetary policy also plays an important role, as European banks are strongly globalized, and emerging market central bankers, such as Raghuram Rajan (2014) Reserve Bank of India Governor, have expressed concern about the spillovers of the United States and Europe's monetary policy on the financial stability of their economies.

In this paper, we study the international credit and risk-taking channel of monetary policy, in particular, the effect of core countries' monetary policy on emerging markets' credit cycles. More specifically, we analyze (i) whether foreign monetary policy affects the supply of credit from foreign banks to local firms, (ii) whether foreign monetary policy shocks have real effects in terms of firm investment, employment, and survival, or whether local firms are able to reduce the effects of such shocks by substituting credit with local banks or with other sources of finance, (iii) whether an expansive foreign monetary policy creates an international risk-taking channel by affecting global banks' reach-for-yield incentives, (iv) whether these effects depend on the type of monetary policy used, that is policy rates versus QE, and (v) whether foreign and local banks finance local credit expansion differently.

Despite the importance of these questions for policy and macro-finance, identification of the effect of foreign monetary policies on the credit and risk-taking channel by foreign banks has not been possible due to a lack of comprehensive credit registry data, that can be matched to firm and bank information, over a sufficiently long period to analyze monetary policy. As we explain below, a matched credit-firm data set is necessary to identify and analyze credit supply, including risk-taking and reach-for-yield, as well as the associated real effects of credit supply. Moreover, while foreign banks are important around the world, they are even more so in emerging markets and developing countries, where they account for around 50% of the market share in terms of loans, deposits, and profits (Claessens and van Horen (2012)).

We overcome these hurdles by using proprietary data from the Mexican banking supervisor. These data contain all business loans over the 2001 to 2015 period, and are matched with firm balance sheet information (including, e.g., firm investment and employment) as well as bank information on ownership and funding. Importantly, this data set includes *all* new and outstanding commercial loans at a monthly frequency from all banks in Mexico, as well as relevant loan terms, including loan rates (which are absent from most credit registers around the world). Moreover, loans issued by foreign banks in Mexico (owned by U.S. and Eurozone and U.K. investors) are important, as the credit

these banks extend to Mexican firms represents roughly 60% of all commercial bank credit in Mexico (which is similar to other emerging markets as shown by Claessens and van Horen (2012)).

To identify the credit and risk-taking channels of monetary policy (Bernanke and Gertler (1995), Stein (1998, 2012), Kashyap and Stein (2000), Adrian and Shin (2011), Maddaloni and Peydró (2011), Rey (2013)), we analyze loan-level data at the *monthly* frequency with borrower (or borrower*month) fixed effects. This allows us to control for unobserved (time-varying) firm fundamentals such as investment opportunities or risk that proxy for credit demand, given that foreign banks may lend to different types of firms (Khwaja and Mian (2008), Mian (2006)). Since only 21% of all firms borrow from multiple banks in a given period, in some specifications we use firm*bank and state*industry*month fixed effects to include firms that, in a given period borrow only from one bank. Note that as period fixed effects control for unobserved global shocks, identification also comes in a given month from differential monetary policies between Mexico, the United States, the United Kingdom, and the Eurozone.[1] To identify the risk-taking channel of monetary policy, we classify borrowers into high- and low-yield groups based on their ex ante loan rates and analyze changes in credit supply, including ex post loan defaults.

To identify the associated real effects, we analyze total bank credit and total (bank and nonbank) firm-level credit availability as well as the dynamics of firm assets, net investment, employment, and a proxy to firm survival due to loan defaults. Analyzing firm-level credit is key as firms could potentially minimize the international monetary policy shocks by substituting their current credit suppliers with credit from other banks or from other sources of finance. Furthermore, in contrast to papers that analyze the effect of local monetary policy on local credit conditions, we examine European and U.S. monetary policies, which are exogenous to the Mexican economy. For monetary rates, we use a measure of Taylor rule-type shocks. For QE, we use the change in the balance sheets of U.S., U.K. and Eurozone central banks as a share of GDP.[2]

We find the following robust results. A foreign policy rate shock affects the supply of credit to Mexican firms mainly via their respective foreign banks in Mexico: U.S., U.K., and Eurozone monetary policies impact the supply of credit to Mexican firms mostly through U.S., U.K., and Eurozone banks, respectively. Furthermore, all loan terms are significantly affected, reinforcing the

[1] Our results suggest similar borrower-observable fundamentals among foreign and local banks and strong exogeneity of firm fundamentals to bank shocks (Altonji, Elder, and Taber (2005)), since, despite the huge increase in R^2 due to unobservables, our estimated coefficients do not change if we control for firm*period rather than state*industry*period fixed effects.

[2] To address concerns about potential endogeneity of foreign monetary policy, (i) we use a proxy for a Taylor rule-type shock, (ii) we control for foreign economic activity in interactions with our main variables, including current and expected annual GDP growth, inflation, and financial risk, and (iii) we instrument for foreign monetary policy. Note that while the Fed and the Bank of England (BoE) pursued QE explicitly as a key nonstandard monetary policy, the European Central Bank (ECB) main nonstandard monetary policy until 2015 was the full provision of liquidity to banks (ECB (2009, 2011)).

supply-driven channel, although the effects are weaker for loan rates. Overall, a one-standard-deviation reduction in foreign monetary policy rates increases the credit volume supplied by foreign banks in Mexico by around 2.1%, lengthens the loan maturity by 6.7%, and increases the probability of future loan default (delinquencies) over the next year by 9.8%, while a one-standard-deviation reduction in the Mexican policy rate raises the loan volume on average by only 0.6%, but for all banks (national and foreign).[3]

We also find that foreign QE has an expansionary effect on the supply of credit to Mexican firms. More specifically, QE originated in the United States and the United Kingdom mainly works through U.S. and U.K. banks, respectively, in Mexico (primarily on credit volume and maturity). Moreover, an increase in foreign QE is related to an increase in loan defaults from Mexican firms to foreign banks over the following year. However, the QE economic magnitudes tend to be lower than those of changes in policy rates. For instance, for U.S. monetary policy, which has the largest economic effects, whereas a one-standard-deviation decrease (increase) in the Fed Funds rate (QE) expands credit volume of U.S. banks by 6% (only 2.5%) and maturity by 9.9% (7.1%).[4]

We also analyze implications of changes in monetary policy at the firm level. While loan-level analysis is needed to identify the supply of credit, including risk-taking, firm-level data are necessary to analyze the substitution of different sources of finance and the associated real effects.[5] We find that the international monetary policy channel has significant real effects, with stronger elasticities from monetary rates than QE. In particular, a one-standard-deviation softening of foreign monetary rate leads to increases of total bank credit volume of 1.5%, average loan maturity of 4.9%, future default rates of 5.3%, firm liabilities of 1.2%, total assets of 0.7%, net investment of 0.5%, employment of 0.4%, and probability of firm survival of one percentage point.[6] In contrast,

[3] This could be because, similar to domestic banks, foreign bank subsidiaries in Mexico have large local retail deposits, and therefore, foreign subsidiaries are also affected by the domestic monetary policy. Note that we summarize the results for softening, but we do not find any statistically significant asymmetric effects, except for expansive nonstandard monetary policy on higher loan defaults.

[4] The speed of transmission of both types of monetary policy shocks is weaker after 12 to 15 months with the effects generally strongest between 6 and 12 months (e.g., the effects on loan volume, rates, and defaults peak at around 12 months). Note, that for QE, results are stronger the lower the CDS of the sovereign where the foreign bank is headquartered, which may explain why QE elasticities are lower, especially for Euro-area banks that suffered a sovereign debt crisis.

[5] As in the loan-level regressions, controlling for firm*month versus state*industry*month fixed effects provides very similar coefficients, the firm-level regressions (where we can only include firm and state*industry*period fixed effects) provide the credit availability channel. Note that results at the loan level are very similar for exporters versus non-exporters.

[6] It also leads to a decrease of 0.1% in loan interest rates. Note that because bank-firm relationships are highly persistent, with only 9% of firms switching their main bank from one year to the next, firms are affected by shocks to the banks they were dealing with in the previous period, and hence by the monetary policy affecting those banks. In addition to defaults (delinquencies) at the loan level, we also analyze a proxy for firm survival/exit due to credit defaults.

a softening of one-standard-deviation in QE increases future loan defaults on banks at the firm level by 6.5% but without significant real effects.[7]

Finally, expansive monetary policy leads to important heterogeneous effects of credit supply. Quantitative effects of the international channel are strongest for local corporate borrowers with higher ex ante loan rates, which proxy for reach-for-yield, with foreign banks engaging in this risk-taking more when foreign monetary policy is expansive. This finding is present along all credit dimensions. For borrowers with high ex ante loan rates (higher than the average), the ex post default rates associated with a one-standard-deviation reduction in foreign monetary policy increase by 11.7%, whereas for the remaining borrowers there is a zero effect. Likewise, a one-standard-deviation expansion of QE leads to an 8.6% increase in the future default rate of firms with higher ex ante loan rates, with a substantially smaller effect on firms with lower ex ante loan rates. Hence, greater risk-taking is associated with ex ante observable variables (previous high loan rates) and with higher ex post defaults. Overall evidence suggests an international risk-taking channel of monetary policy through foreign monetary policy rates and QE.

At the bank level, we find that when foreign monetary policy is softer, foreign subsidiaries take on more liabilities (especially foreign and short-term), experience more loan defaults, and higher expansion of the balance sheet. Hence, our results are consistent with banks taking on greater liquidity risk (with higher bank funding via foreign bank liabilities, which tend to be more fragile) and greater credit risk (providing more credit to riskier ex ante and ex post borrowers) and despite shorter-term foreign liabilities, lending at longer maturities on the asset side of their balance sheet.

The results are consistent with spillovers of core countries' monetary policies to emerging markets, both in the foreign monetary softening part (with higher liquidity and credit risk taken by foreign banks) and in the tightening part (with negative local firm-level real effects). When U.S. and European monetary policies are softer, global banks have more liquidity but lower yields in domestic markets, so they expand to emerging markets reaching for higher yield, with higher credit and liquidity risk-taking, and thus create a local credit boom. When monetary policy becomes tighter, they withdraw from emerging markets, creating a credit crunch with negative firm-level real effects.

Our key contribution is identification of the *international* risk-taking and credit channel of monetary policy via foreign banks, which allows us to pin down the associated credit supply channel, including spillovers on real effects, and risk-taking, both ex ante reach-for-yield and ex post defaults. In particular, our paper contributes to the literature analyzing the international channel of monetary policy. Cetorelli and Goldberg (2012a, 2012b) provide direct evidence that global banks manage liquidity on a global scale, actively using cross-border internal funding in response to local shocks. We extend this literature

[7] Apart from the crisis effects measured by CDS (see a previous footnote), QE results are lower due to high standard errors in firm-year data; for example, firm-level results on loan outcomes using monthly level data are all statistically significant.

by showing that local credit supply, including the associated local real effects and risk-taking, is affected by foreign monetary policy shocks through foreign (global) banks.[8] It is important to stress that foreign banks are crucial to emerging markets (Claessens and van Horen (2012)). Our findings are important given the recent policy debate about the impact of U.S. and European QE/tapering and monetary policy rate tightening on emerging markets.

Our paper also contributes to the literature analyzing the risk-taking channel of monetary policy. Expansive monetary policy rates may promote higher risk-taking by banks and other financial institutions, as argued by IMF Chief Economist Raghuram Rajan (2005), Federal Reserve Governor Jeremy Stein (2013), and Adrian and Shin (2011), among others, and there is empirical evidence for this channel at the local level (e.g., Jiménez et al. (2014), Dell'Ariccia, Laeven, and Suarez (2017)).[9] We show that this channel is also present at the international level (Rey (2013), Miranda-Agrippino and Rey (2015), Bruno and Shin (2015a, 2015b)), in particular, that low monetary policy rates and QE in high-income countries lead global banks to increase the supply of credit in emerging markets to reach for higher ex ante yield, and as a result observe higher ex post loan defaults.

Finally, we contribute to the recent literature on the credit channel of monetary policy that analyzes the impact of monetary policy at the loan level (e.g., Jiménez et al. (2012, 2014)) by showing the real effects associated with credit availability. Since these loan-level papers do not match their credit register data with firm level data, they cannot analyze the real effects. Nevertheless, real effects of monetary policy through the banking sector may be crucial, as shown by recent theoretical papers (Diamond and Rajan (2006), Gertler and Kiyotaki (2010), Kiyotaki and Moore (2012), Gertler and Karadi (2011)). Some empirical papers using aggregate macro data have analyzed the real effects of monetary policy (Bernanke and Blinder (1992)), but as we explain in this paper, matched loan level data is necessary for the identification of credit supply and real effects. Bank-level data (e.g., as in Kashyap and Stein (2000)) cannot identify credit supply, or *firm*-level real effects. Hence, another contribution of

[8] Our paper also contributes to the literature in international banking (Peek and Rosengren (2000), Mian (2006), Acharya and Schnabl (2010), Schnabl (2012), Giannetti and Laeven (2012), Popov and Udell (2012), De Haas and van Horen (2012, 2013), Jeon, Olivero , and We (2013)) by analyzing the effect of monetary shocks transmission through foreign banks on credit supply and the real economy. Note that a large part of financial globalization occurs through banks (Kalemli-Ozcan, Papaioannou, and Peydro (2013)).

[9] See also Altunbas, Gambacorta, and Marques (2014) and Paligorova Santos (2017) as well as the models of Allen and Gale (2000, 2004) summarized in Allen and Rogoff (2011), Borio and Zhu (2008), Shleifer and Vishny (2010), Diamond and Rajan (2012), and Cuadra and Nuguer (2016). Expansive monetary policy by increasing the funding provided by households and other agents to banks may increase risk-taking, as banks face strong moral hazard problems. A low short-term interest rate makes riskless assets less attractive and may lead to a reach-for-yield by those financial intermediaries that have short-term horizons. Ioannidou, Ongena, and Peydro (2015) analyze risk-taking on loans in Bolivia (with a dollarized credit market) but do not analyze foreign banks or real effects due to credit.

our paper is to show the real effects of the bank lending channel of monetary policy.[10]

The remainder of the paper is structured as follows. Section I summarizes the empirical strategy, including the data and institutional details. Section II presents the results, and Section III concludes.

I. Empirical Strategy

In this section, we discuss the data and institutional details, along with empirical identification, and the econometric tests that we run at the loan, firm, and bank levels. In our empirical analysis, we use three main data sets. The first data set contains monthly supervisory information on commercial bank lending at the loan level. The second data set contains annual balance sheet and income statement information at the firm level from nonfinancial firms. The third main data set contains supervisory aggregate monthly information at the bank level, including balance sheet and income statements. Overall, the supervisory monthly data sets span from June 2001 to December 2015, while the annual data set runs through 2014. We also use macroeconomic information, including local and international monetary policy variables.

The first data set, at the loan level, uses supervisory information on the universe of business loans. The data come from reports sent monthly by each commercial bank to the regulator. Reports are mandatory, updated electronically, and include detailed characteristics on all new and continuing loans extended to firms by each bank in Mexico. Notably, all business loans must be reported regardless of their size. Thus for each loan, we know the issuing bank, the borrower (firm), the outstanding balance, the (annualized) interest rate, the start and ending dates of the loan (maturity), the fraction covered by collateral, as well as certain firm details, such as its location and industry. Since loans are tracked each month, we can observe their evolution until maturity, including whether the debtor obligations are being fulfilled, and if they are not, for how long the loan has been underperforming and by how much. To ensure consistency of the data and to examine real effects associated with credit, we exclude from our study loans to individuals pursuing entrepreneurial activity, which restricts our analysis to loans to commercial firms, as the data we use to study real effects on firms has balance sheet information only for commercial firms, not for individual entrepreneurs.

[10] Loan-level data are crucial to identify credit supply (and risk-taking), especially as, for example, foreign banks may lend to different type of firms, and matched firm-credit-level data are needed to measure the real effects of credit at the firm level, differentiating firms by the extent to which they are affected by foreign banks. Additionally, our paper contributes to the literature by analyzing the lagged transmission of monetary policy on loan and firm outcomes, and by analyzing the effect of monetary policy on loan rates (our results are consistent with theoretical literature that argues that banks may adjust lending volumes more than rates; see Stiglitz and Weiss (1981) and the literature following this paper).

We aggregate observations at the firm-bank-month level, which results in 8,268,794 observations that we refer to as "loans."[11] For the vast majority of variables, we aggregate individual loans using a weighted average by loan volume; the only exception is loan volume, which is the sum of all outstanding loans that a firm has from a certain bank in a given month. Table I presents summary statistics for our main variables of interest. The average credit volume is MXN 2,244,000 (roughly USD 172,000), while the median loan is close to USD 30,000. The median loan interest rate and maturity are 15% and 36 months, respectively. The average collateral value is 26%, while the average default rate (which following prior literature corresponds to the fraction of loans that are in arrears for more than 90 days) is 7%. See Table A.I in the Appendix for the detailed definitions of all variables used in the paper.

The macroeconomic and policy variables used in our empirical analysis are also summarized in Table I and in Figure 1. The Mexican monetary policy rate used is the *Tasa de Interés Interbancaria a 1 Día* (variable *intrate-mex*), while the U.S., U.K., and Eurozone policy rates are the *Fed Funds* rate (*intrate-us*), the SONIA rate (*intrate-uk*), and the EONIA rate, respectively (*intrate-euro*). Given that the Mexican economy is a small open economy that is highly affected by the U.S. economy, we run an OLS regression of the Mexican overnight interest rate on Mexican annual real GDP growth and CPI inflation, as well as on the Federal Funds rate and U.S. annual real GDP growth and CPI inflation, and use the residuals (*intrate-mexr*) in our benchmark regressions to isolate movements in the domestic monetary policy that are not explained by movements in the Mexican or U.S. economic activity. Similarly, we regress the overnight rates of the foreign central banks–U.S., Eurozone, and U.K.–on their respective annual real GDP growth and CPI inflation. For example, the variable *intrate-usr* is the residual from the regression of the Fed Funds rate on U.S. annual real GDP growth and CPI inflation, proxying for a Taylor shock, and accounts for any movement in the monetary policy from the United States that is not related to the U.S. business cycle. Given the synchronization of the world economy, one possible concern is multicollinearity of monetary policies. However, as can be seen in Figure 1, since we are controlling for business cycles, the correlations between the residual monetary policies are relatively moderate.[12]

[11] To ensure the comparability of our results across banks, and given our focus on corporate lending, we exclude from our analysis banks that specialize in consumer lending as well as niche banking. These banks comprise less than 3% of the value of total corporate bank lending and less than 1% of the number of corporate loans. Around 97% of the number of loans in our data are denominated in Mexican pesos. We restrict our analysis to loans in domestic currency. Including loans in foreign currency does not alter our results in any significant way.

[12] For example, the correlation between *intrate-usr* and *intrate-euro* is 0.38. Moreover, the correlations up to mid-2009, when policy rates hit the zero-lower bound, are around 0.15. As a robustness test, in Table IA.VII of the Internet Appendix we replicate our results using that subsample. In addition, we analyze QE measures (described below) cleaned by economic activity, and we run a specification using the residual of an OLS regression of the Mexican overnight interest rate only

Table I
Summary Statistics

This table reports the definitions for all variables. Loan-level data at the loan-month and firm-year levels comprise 8,268,794 and 747,910 observations, respectively, and 14,563 firm-year observations from Orbis (see Tables A.I and A.II in the Appendix for more detailed information); all variables from the Orbis sample are in thousands of Mexican pesos, except *employment.*^{Y}

Variable	Mean	Median	St. Dev
Variables at the Loan-Month Level			
loan volume (thousands of Mexican pesos)	2,244	379	6,168
loan maturity (months)	33.2	36.0	21.1
loan collateral	0.26	0.00	0.52
loan rate	0.15	0.15	0.07
loan default	0.07	0.00	0.26
intrate-us	0.015	0.002	0.019
intrate-uk	0.024	0.005	0.022
intrate-euro	0.017	0.010	0.015
intrate-mex	0.058	0.046	0.018
intrate-usr	−0.002	−0.007	0.017
intrate-ukr	0.000	−0.002	0.020
intrate-euror	0.000	−0.003	0.012
intrate-fgnr	0.000	0.000	0.014
intrate-mexr	0.000	−0.001	0.010
qe-us	0.022	0.013	0.027
qe-uk	0.018	0.004	0.030
qe-euro	0.015	0.013	0.032
qe-fgn	0.002	0.000	0.028
bank-us	0.152	0.000	0.359
bank-uk	0.134	0.000	0.341
bank-euro	0.323	0.000	0.468
bank-mex	0.386	0.000	0.487
Variables at the Firm-Year Level			
loan volume^{Y} (thousands of Mexican pesos)	25,795	3,304	86,906
loan maturity^{Y} (months)	33.1	34.3	22.8
loan collateral^{Y}	0.27	0.00	0.57
loan rate^{Y}	0.15	0.15	0.08
loan default^{Y}	0.06	0.00	0.24
exit^{Y}	0.04	0.00	0.19
intrate^{Y}*-fgnr*share*^{Y}*-fgn*	0.000	0.000	0.010
intrate^{Y}*-mexr*share*^{Y}*-mex*	0.000	0.000	0.004
qe^{Y}*-fgn*share*^{Y}*-fgn*	0.001	0.000	0.022
Variables at the Firm-Year Level (Orbis sample)			
assets^{Y}	308,128	19,850	1,105,935
fixed assets^{Y}	95,202	3,042	354,762
liabilities^{Y}	110,190	9,350	362,078
noncurrent liabilities^{Y}	22,949	0	94,264
current liabilities^{Y}	82,555	8,180	216,639
employment^{Y} (units)	115	40	177

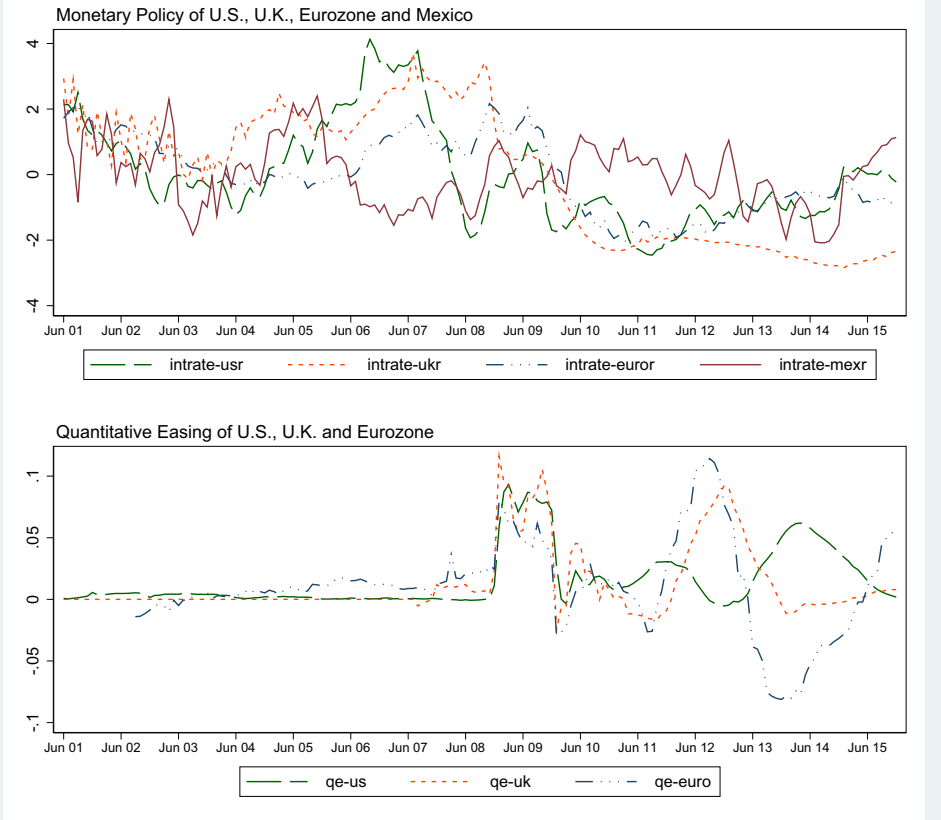

Figure 1. Monetary policies and quantitative easing June 2001 to December 2015. The first figure plots the residuals from regressions of the foreign monetary policies (EONIA rate for the Eurozone, SONIA rate for the United Kingdom and Fed Funds rate for the United States) on the annual growth rate of real GDP and CPI of each region over time, as well as the residuals from a regression of the Mexican monetary policy (Tasa de Fondeo Bancario) on the Fed Funds, and the annual growth rates of CPI and real GDP for both Mexico and the United States. The second figure plots the evolution of quantitative easing over time in the Eurozone, United Kingdom, and United States, respectively. Quantitative easing is measured as the annual real change in total balance sheet assets of each central bank (ECB, BoE, and Federal Reserve) as a share of GDP in each region. (Color figure can be viewed at wileyonlinelibrary.com)

After the Lehman failure, U.S. and European overnight interest rates went to very low levels, especially in 2009. Central banks therefore engaged in various nonstandard policies such as large-scale asset purchases and unlimited lending to banks with the objective of stimulating the economy. In our analysis, we explore all of these nonstandard policies across the core central banks using

on the Mexican macro variables. The results are qualitatively similar. The Internet Appendix is available in the online version of the article on this *Journal of Finance* website.

the variables *qe-us*, *qe-uk*, and *qe-euro,* which are the annual real change in the balance sheet of the respective central bank as a share of GDP. All three central banks increased sharply their asset holdings in the third quarter of 2008, by around 8% to 10% of GDP. Going forward, however, these programs exhibited different purchasing patterns (see Figure 1 and Table I) that are important for identification. In particular, while the Federal Reserve, and to a lesser extent the Bank of England (BoE), maintained their purchasing rate for a full year through the third quarter of 2009, the ECB decreased its buying rate sharply by early 2009. In the second half of 2010, the Federal Reserve boosted its program (dubbed QE2), while the BoE and ECB only started to increase their purchasing programs in the second half of 2011 (the ECB introduced its 3-year long-term refinancing operation (LTRO) in December 2011). Since 2013, there has been further divergence between central banks. For example, while the Fed pursued tapering, a reduction in asset purchases, the ECB started its target LTRO program and QE. Overall, since the start of the financial crisis, the Fed, the ECB, and the BoE expanded their balance sheet as a share of GDP by an average of 15 percentage points, but with significant differences in intensity and direction over time.

Table I also presents summary statistics of dummy variables indicating whether the loan is from a Mexican, U.S., U.K., or Eurozone owned bank (*bank-mex, bank-us, bank-uk,* and *bank-euro*, respectively). As can be seen, 39% of loans are from Mexican banks, followed by Eurozone banks, at 32% of loans, U.S. banks at 15%, and U.K. banks at 13% of the loans.

The second main data set that we use, Orbis, contains annual information on the balance sheet and income statement information. We use these data to examine whether movements in foreign monetary policy have real effects on firms. To do so, we aggregate the credit data to one observation per firm-year. Table I presents summary statistics of the firm-year-level data set. The variable, $loan\ volume,^{Y}$ is the sum of all outstanding bank loans that a firm has in a given year across banks, and $loan\ maturity^{Y}$ is the average maturity of all bank loans that a firm has in a given year weighted by loan volume. Similarly, the variables $loan\ collateral,^{Y}$ $loan\ rate,^{Y}$ and $loan\ default^{Y}$ correspond to the weighted averages of the collateral, interest, and default rates of all bank loans that a firm has in a given year, again weighted by their respective loan volume. Finally, $exit^{Y}$ is an indicator variable that takes the value of one if a firm with a loan in default drops from the loan-level data set in a given year until the end of the sample and thus proxies for firm closure. Combining the credit data with Orbis results in a significant loss of observations, since for many firms the observation in Orbis is missing. Nevertheless, we successfully match around 14,563 firm-year observations with information on firms' total assets, fixed assets (whose variation provides net investment), and total employment, as well as firms' total, current, and noncurrent liabilities, which allows us to check for other sources of firm finance. The vast majority of firms in Orbis, around 98%, are nonlisted firms. Using the employment information from the loan-level data, we find that the Orbis sample is not very different from the universe of firms (see Table IA.V in the Internet Appendix), although it is biased

toward larger firms.[13] Moreover, as we show in Table IA.XIX in the Internet Appendix, the results on real effects are stronger for smaller firms. Our results based on firm balance sheet information can thus be thought of as lower-bound estimates of the real effects of the average firm in Mexico.

To identify real effects at the firm level, we aggregate information at the firm-year level. Accordingly, we weigh the monetary policy (both standard and nonstandard) of each country by the share of loans that a firm had with banks from the country in the previous year. The intuition is as follows. If a firm borrows only from one bank (say a U.K. bank), then the most relevant monetary policy for the firm outcomes due to the bank lending channel should be the U.K. monetary policy. To see this, assume that in the previous year 40% of a firm's debt came from U.K. banks and 60% from Mexican banks. If firm-bank relations are persistent, which in our data set they are, then the most relevant monetary policies for this firm are those from the United Kingdom (with a 0.4 weight) and Mexico (with a 0.6 weight).[14]

For each firm, the variable $intrate^{Y}$-*mexr***share*^{Y}-*mex* refers to the annual Mexican monetary policy times the share of bank credit that a firm had with Mexican banks in the previous year. Similarly, the variable $intrate^{Y}$-*fgnr***share*^{Y}-*fgn* is the annual average of the U.S., U.K., and Eurozone monetary policy rates, weighted by the share of debt that a firm had with U.S., U.K., and Eurozone banks, respectively, times the share of foreign loans in the previous year. These aggregate monetary policy variables allow us to investigate whether firms with higher shares of credit from banks of a particular country are more vulnerable to changes in the monetary policy of that country. If firms could switch banks at no cost, then their past banking relationships should not impact their current or future real activity following a particular monetary policy shock, since they could smooth the shock by switching to other banks or by switching to other sources of financing. However, if switching banks is costly, then the effect of, say, a U.K. monetary policy shock (through U.K. banks) can have real effects on outcomes of Mexican firms that are dependent on U.K. banks.

Our third main data set contains monthly aggregate information on banks' financial statements, including balance sheets, and income statements. We use these data to analyze the banks providing commercial loans, to control for their characteristics, and to test how different sources of bank funding are affected by international monetary policy shocks. The banking system has been dominated

[13] The Internet Appendix is available in the online version of this article on this *Journal of Finance* website.

[14] We find that bank-firm relationships are indeed sticky, with only 9% of firms switching their main bank from one year to the next. Furthermore, persistence in bank-firm relations does not differ across foreign and domestic banks (see Table IA.VI in the Internet Appendix). Regarding the switching determinants, we find that switching rates are positively related to firm size and to the number of banks that the firm has relationships with, and negatively related to a loan's duration and volume. Somewhat surprisingly, if we define small (large) firms as those with fewer (more) than 50 employees (as in Beck and Demirguc-Kunt (2006)), we find that the switching rates are somewhat similar at 8% and 11%, respectively.

by five large banks that comprise 72% of total bank assets, a pattern that exists in most countries. Four of these banks are foreign-owned subsidiaries of major international banks from the United States, United Kingdom, and the Eurozone, with one, one, and two banks respectively. The remaining banks are mostly domestic and represent a heterogeneous group that focuses on different segments, such as corporate and consumer lending as well as niche banking.

Table IA.II in the Internet Appendix presents summary statistics for all the commercial banks in our sample. The top half of the panel displays the results for common bank measures such as total assets, liquidity, and capital ratios as well as return on assets, while the bottom half shows the fraction of commercial loans in each sector. The Mexican banking system as a whole is profitable, liquid, and well capitalized, with average return on assets of 1.0% and average return on equity of 12.9% over the period 2001 to 2015. For comparison, during the same period the average return on assets for U.S. banks was 1.0% while their average return on equity was 10.4%. The remaining columns of the table present the statistics for the largest five banks, divided by the country of their parent bank. As highlighted in the table, relative to the largest foreign banks, the characteristics of the largest Mexican bank are comparable. We note that our results go through if we only analyze the five largest banks in Mexico (see, e.g., Table IA.XIII in the Internet Appendix).

Apart from the banking sector, capital markets in Mexico are very small and used exclusively by the largest corporations (see, e.g., IMF (2012), Carabarin, de la Garza, and Moreno (2016)). Shadow banking has grown as an alternative form of financing for firms over the last decade, albeit from a very low base. As of 2014, the assets from the shadow-banking sector, defined as financial entities not subject to traditional banking regulation, represented 16% of Mexico's GDP, compared to 42% for the banking industry (Banco de Mexico, 2014). Therefore, even though Mexico is a bank-dominated economy, we also analyze the extent to which firms substitute with other sources of liabilities, in particular, total firm liabilities, as well as current and noncurrent liabilities.

Finally, to shed light on whether banks engage in reach-for-yield as monetary policies become more expansive, we split our sample into two groups based on the (ex ante) loan rates that firms paid in the previous quarter. More specifically, each period we calculate the average loan interest rate charged to all Mexican firms, weighted by loan volume. We then classify firms above (below) this threshold as high-yield (low-yield) firms. The loan characteristics of these two groups are reported in Table IA.III in the Internet Appendix. As can be seen, low-yield firms pay lower interest rates (by definition) and have substantially higher collateral rates and lower default rates compared to high-yield firms, which suggests that they are indeed less risky.

As discussed earlier, we use regressions at the *loan-month* level (more specifically, firm-bank-month level) to identify changes in firms' credit margins, and regressions at the *firm-year* level to examine changes in firms' real effects and credit substitution. Below we discuss the loan-level tests. We then discuss our firm-level tests.

A. Outcomes at the Loan Level

Our main objective is to understand whether foreign monetary policy shocks are transmitted to local firms through banks from the countries in which the shocks occur (e.g., Eurozone monetary policy transmitted by Eurozone banks in Mexico through their lending to Mexican firms). To do so, we investigate whether credit availability of a given bank is particularly affected by changes in the monetary policy of the country in which the bank is headquartered. As borrowers from different banks can be different, we need to analyze firm-bank-month data for identification.

Our baseline specification is given by equation (1), which is an OLS regression that relates the credit outcome of each firm-bank pair in a given month to the quarterly lagged monetary policies (both traditional and nonstandard monetary policies) of each of the four countries considered. Each monetary policy is also interacted with an indicator variable that equals one if the bank providing the loan is headquartered in the given country and zero otherwise. For example, a loan given by a U.K. bank will have the value of zero for all of the dummies except that for U.K. monetary policy. The baseline specification is as follows:

$$y_{i,b,t} = \rho + \sum_{country} [\alpha_{country} intrate\text{-}country_{t\text{-}3} + \beta_{country} intrate\text{-}country_{t\text{-}3} * bank\text{-}country_b] + \sum_{country} [\gamma_{country} qe\text{-}country_{t\text{-}3} + \delta_{country} qe\text{-}country_{t\text{-}3} * bank\text{-}country_b] + X_{b,t} + \varepsilon_{i,b,t}. \quad (1)$$

In equation (1), $y_{i,b,t}$ corresponds to the credit outcome y of firm i that has a loan with bank b in month t, where credit outcome y is one of log(loan volume), log(loan maturity), collateral rate, loan rate, or the fraction of loans in default 12 months ahead.[15] The regressor $intrate\text{-}country_{t\text{-}3}$ is the one-quarter-lagged monetary policy rate of $country = \{U.S., U.K., Euro, Mex\}$, $bank\text{-}country_b$ is a bank nationality's indicator.[16] The regressor $qe\text{-}country_{t\text{-}3}$ measures the annual

[15] For robustness, we also tested for the fraction of loans in default 6 and 24 months ahead. The main results continue to hold in all specifications.

[16] In our analysis, we use the residuals of the regression of monetary policy on macro movements *intrate-countryr* instead of *intrate-country* to isolate monetary policy shocks from changes in rates due to business cycle movements. More specifically, to calculate *intrate-mexr*, we use the residuals of the regression of *intrate-mex* on Mexican and U.S. annual real GDP growth and CPI inflation, as well as on *intrate-us*. For the remaining countries we use the residuals of the regression of *intrate-country* on *country* annual real GDP growth and CPI inflation. For simplicity, the residuals of the monetary policy regressions described above are referred to as "monetary policy rates" in the empirical strategy and results sections. We also use lags of monetary policy other than one quarter. Specifically, in robustness tests, instead of using the monetary policies with one-quarter lag, we ran specification (1) using alternative monetary policies with lags up to 24 months. We find

real change in the balance sheet of the central bank (over its GDP) of a country in the previous quarter (t-3). Moreover, additional controls included in $X_{b,t}$ are the one-quarter lagged annual growth rates of all countries' GDPs and CPIs (all in levels and interacted with the indicator variables of banks' nationalities) as well as sovereign CDS. These variables allow us to control for the business cycles, and to better isolate changes in monetary policy from other changes in economic activity.[17]

Equation (1) also includes several fixed effects. A key challenge of our empirical strategy is that different banks may have borrowers with different characteristics, complicating the identification of the (international) bank lending (supply) channel of monetary policy. To achieve identification, we first saturate our loan-level specification with fixed effects at the firm*bank level.[18] This allows us to exploit the variation within the same firm and bank over time. This not only controls for unobserved, time-invariant, firm heterogeneity (industry, location, ownership) and bank heterogeneity, but also for sticky firm-bank relationships. Our identification comes from the fact that within a period, banks from different nationalities may be differently affected by the monetary policy shocks of their respective countries.

We also include in some specifications firm*month fixed effects. By doing so, we examine whether for a given firm in a given month, the loans offered by different banks depend on the monetary policy shocks of their parent countries. In this case, we control exhaustively for unobserved time-varying firm fundamentals (such as firm risk, investment opportunities, and balance sheet characteristics). One drawback of the specifications that include firm*month fixed effects is that they restrict the sample to firms that at a given point in time have loans with more than one bank. These firms represent only 21% of the sample firms, and together hold 37% of the loans. This exercise could therefore bias our results since these firms tend to be larger and older. Accordingly, in some specifications instead of using firm*month fixed effects, we use state*industry*month fixed effects to proxy for demand shocks. However, in order to determine whether differences across specifications are due to unobservables or to the sample selection of firms, we run the latter specification twice: first using all of the firms in our data, and then using only firms with multiple bank relationships.

As further robustness checks, we test the validity of the bank-lending channel by analyzing the effect of foreign monetary policy on different subsamples of

that up to 12 months, all of these tests yield qualitatively similar results. After 12 to 15 months, the coefficients start to become statistically indistinguishable from zero.

[17] When we saturate the regressions with different sets of time fixed effects to control for time-varying unobservable heterogeneity in fundamentals, the macro controls are spanned by these fixed effects (including all unobserved time-varying bank fundamentals). In addition to controlling for global shocks via month fixed effects, we control for foreign economic activity in interactions with our main variables, as this could be a separate channel of influence.

[18] Importantly, note that identification is not possible with just bank—or firm-level—data, as different banks may lend to different types of firms. For example, foreign banks could lend to firms that tend to export more.

firms, such as firms in more tradeable versus less tradeable sectors (e.g., Mian and Sufi (2014)), and firms located in northern versus southern states, see Tables IA.IX and IA.X of the Internet Appendix. Note that period fixed effects control for unobserved global shocks, and hence identification also comes in a particular period from the differential monetary policies among Mexico, the United States, the United Kingdom, and the Eurozone. Since our identification further compares lending from different foreign banks (themselves shocked by their home monetary policy), it follows that borrower selection is less of an issue.[19] Note that time fixed effects imply that we identify how foreign monetary policies affect foreign versus domestic banks in lending to a given firm (or industry-location) in a given month. Finally, to identify the risk-taking channel of monetary policy, we test equation (1) on firms with high versus low ex ante loan yield and analyze all credit outcomes, including (ex post) loan defaults.

B. Outcomes at the Firm Level

While monetary policy shocks may be passed to firms through the bank lending channel, the real impact on firms may not be substantial if, for instance, firms can smooth the shocks by switching banks, or by replacing bank credit with other sources of finance, such as market debt, including finance from the shadow banking sector. Therefore, to analyze real effects, we need to examine firm-level data (matched with credit data to differentiate firms across their dependence on foreign banks and hence on monetary policy). The specification that we use for the effect of monetary policy shocks on firm credit and for other real effects is as follows:

$$\begin{aligned} y_{i,t}{}^{Y} = \theta + \lambda_{mex}\ & intrate^{Y}\text{-}mexr_{t}{}^{*}share^{Y}\text{-}mex_{i,t\text{-}1} \\ & + \lambda_{foreign} \sum_{country} intrate^{Y}\text{-}country_{t}{}^{*}share^{Y}\text{-}country_{i,t\text{-}1} \\ & + \mu_{foreign} \sum_{country} qe^{Y}\text{-}country_{t}{}^{*}share^{Y}\text{-}country_{i,t\text{-}1} + \int_{i,t}. \end{aligned} \tag{2}$$

The dependent variable y^{Y} corresponds to: (i) the bank-credit outcomes aggregated at the firm-year level (*loan volume*^{Y} and *loan maturity*^{Y} in logs, *loan collateral,*^{Y} *loan rate,*^{Y} and *loan default*^{Y}), (ii) an indicator for whether

[19] For instance, we find that within the largest banks, borrowers are not statistically different. Using loan- and firm-level information, we find that across the largest banks (which include one domestic bank as well as banks from the U.S., the U.K., and the Euro Area), borrowers have similar characteristics in terms of their bank credit volume and total assets (see Table IA.IV of the Internet Appendix) and, therefore, conditional on borrowing from the largest banks, firms with loans from U.S., Eurozone, or U.K. banks are not statistically different from each other or from firms with loans from the largest Mexican bank. Interestingly, we also confirm that our main results hold for firms only borrowing from large banks, whether foreign or Mexican (see Table IA.XIII in the Internet Appendix).

a firm with loan defaults shuts down in a given year ($exit^Y$), (iii) firm total, current, and long-term liabilities ($liabilities,^Y$ $current\ liabilities^Y$ *and* $noncurrent\ liabilities^Y$), and (iv) firm total assets ($assets^Y$), fixed assets ($fixed\ assets^Y$ whose variation proxies for net investment), and employment ($employment^Y$). The last six variables (from Orbis) are in logs and only available at the annual frequency, and thus the main regressions at the firm level are at the firm-year level (to facilitate comparison purposes with the variables at the loan level we also run the regressions at the monthly level for bank credit related variables).

The first covariate, $intrate^Y\text{-}country_t{*}share^Y\text{-}country_{i,t\text{-}1}$, refers to the average monetary policy rate of $country = \{U.S.,\ U.K.,\ Euro,\ Mex\}$ in year t times the share of the previous year's bank loans that a firm had with banks headquartered in a given country (see the previous subsection and Appendix Tables A.I and A.II for variables' definitions). Similarly, $qe^Y\text{-}country_t{*}share^Y\text{-}country_{i,t\text{-}1}$ corresponds to the annual average QE of $country = \{U.S.,\ U.K.,\ Euro\}$ times the 1-year-lagged share of a firm's loans with a bank from that country. Given our interest in contrasting foreign versus domestic banks, we aggregate the foreign monetary policies (weighting each foreign policy by the lagged share of loans that a firm has with banks from each foreign country), using $intrate^Y\text{-}fgnr_t{*}share^Y\text{-}fgn_{i,t\text{-}1}$, and $qe^Y\text{-}fgn_t{*}share^Y\text{-}fgn_{i,t\text{-}1}$, and we calculate two coefficients ($\lambda_{mex},\ \lambda_{foreign}$) for the monetary policy rates and one coefficient ($\mu_{foreign}$) for QE.

In contrast to specification (1), on the left-hand side of (2) we analyze *all* bank credit to a firm in a given year. The right-hand side of this specification consists of a measure of firm-level exposure to each monetary policy shock that is based on previous bank relationships. Given that banking relationships are sticky over time (see Table IA.VI of the Internet Appendix for our Mexican data and Ongena and Smith (2001) for other countries), the assumption behind this specification is that the intensity of the monetary policy shock of a particular country is proxied by the previous year's share of a firm's debt with banks from that country.

Finally, we saturate our specification with fixed effects at the firm level, which allows us to control for time-invariant unobserved firm heterogeneity (such as location), and at the state*industry*year level, which allows us to control for time varying borrower fundamentals (and exploit the variation across loans from different banks to the same industry, in the same location and the same period). Importantly, as we discuss in Section II, following Altonji, Elder, and Taber (2005), the loan-level regressions show that controlling for firm*period fixed effects provides similar coefficients to controlling only for firm and state*industry*period fixed effects (i.e., results suggest that both specifications similarly control for borrower fundamentals). Therefore, the firm-level regressions, where we cannot include firm*year fixed effects, but we can include firm and state*industry*year fixed effects, can be interpreted as identifying the credit availability channel.

In sum, in equation (2) we investigate whether firms are able to smooth monetary policy shocks of a foreign country by switching banks or by switching

to other sources of finance. If firms can easily switch banks to smooth shocks, the coefficients $\lambda_{foreign}$ and $\mu_{foreign}$ should not be statistically different from zero. Thus, this equation tests whether a monetary policy shock for the country of origin of the firm's previous banks influences the firm's overall bank credit in the current year. If changing banks is relatively easy, previous bank relationships should not be important and monetary policy shocks should have little real effect on a firm.

Since we also analyze firms' total (current and noncurrent) liabilities, we can ensure whether firms replace bank credit with other types of debt, or whether foreign monetary policy shocks that are passed through the bank lending channel have a binding effect on firms' overall liabilities. In the latter case, the coefficients $\lambda_{foreign}$ and $\mu_{foreign}$ on $liabilities^Y$, $noncurrent\ liabilities^Y$, and $current\ liabilities^Y$ should be statistically different from zero. Finally, if bank credit and overall liabilities are affected, real effects stemming from foreign monetary shocks are likely to exist. We test for this possibility by looking at the change in firms' total assets and employment as well as firm net investment (variation of fixed assets).[20]

II. Results

This section presents our findings. We use data at the borrower-lender-month (loan) level to analyze the effects of foreign monetary policy on banks' credit supply and risk-taking. To study the associated real effects and credit substitution, we use data at the firm-year level.

A. Loan-Level Credit Supply Outcomes

Panel A of Table IIA presents results on the effect of the various foreign monetary policies on the volume of loans to firms in Mexico. The first column reports results of the baseline specification outlined in equation (1) controlling for fixed effects at the firm*bank level. As the results show, the three different foreign monetary policy rates have stronger effects on credit outcomes of banks from the same country. That is, U.S., U.K., and Eurozone policy has greater

[20] We further analyze bank-level data at the monthly frequency to see whether our findings also hold at a more aggregate level, and to better understand the mechanism underlying our results. Using this data set, we examine the sensitivity of the total bank assets, the various bank liability measures and share of credit in arrears of foreign and domestic banks to movements in monetary policies. The results are presented in Table IA.VIII in the Internet Appendix, where the regressors are: *intrate-fgnr*bank-fgn*, which is the one-quarter lagged foreign monetary policy rate residual times an indicator variable that equals one if the bank is foreign; *intrate-mexr*bank-mex*, the one-quarter lagged residual of the Mexican policy rate times an indicator variable that equals one if the bank is headquartered in Mexico; and *qe-fgn*bank-fgn*, which is the one-quarter-lagged annual change in the balance sheet of the corresponding central bank over GDP times an indicator variable that equals one if the bank is of foreign origin. We also include macro controls, namely, annual GDP and CPI growth, a linear trend for each country/region where banks are headquartered (to allow for different growth rates of the regions examined), and period and bank fixed effects.

Table IIA

Panel A Impact of International Monetary Policies on Domestic Loan Volume

This table reports the estimates from OLS regressions for the period June 2001 to December 2015. Observations are at the firm-bank-month level. The dependent variable is the volume of loans, in logs, from a firm with a bank in a given month. *intrate-countryr* is the residual policy rate of *country*, where *country* stands for United States, United Kingdom, Euro Area, or Mexico. *qe-country* is the ratio of the annual real change in central bank assets to GDP of *country. bank-country* is a dummy indicating whether bank headquarters are in *country*. Other controls are listed in Section II. Fixed effects already absorbed by other fixed effects are indicated by "-." Standard errors are reported in parentheses and are clustered at the period and bank-industry levels, where period is month. *,**,*** significant at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
intrate-usr	−0.19			
	(0.16)			
*intrate-usr * bank-us*	−2.93***	−3.55***	−3.21***	−3.31***
	(0.34)	(0.40)	(0.35)	(0.54)
intrate-ukr	−0.11			
	(0.30)			
*intrate-ukr * bank-uk*	−1.05**	−2.42***	−2.11***	−2.45***
	(0.49)	(0.54)	(0.46)	(0.74)
intrate-euror	2.05***			
	(0.63)			
*intrate-euror * bank-euro*	−2.10**	−1.70*	−1.12**	−0.63
	(0.82)	(0.97)	(0.54)	(0.82)
intrate-mexr	−0.59***			
	(0.19)			
*intrate-mexr * bank-mex*	−0.03	0.58	−0.03	−0.10
	(0.32)	(0.47)	(0.47)	(0.75)
qe-us	−0.52***			
	(0.10)			
*qe-us * bank-us*	0.56**	0.95***	0.85***	0.90***
	(0.26)	(0.26)	(0.20)	(0.28)
qe-uk	−0.04			
	(0.11)			
*qe-uk * bank-uk*	0.65***	0.70**	0.58*	0.55
	(0.19)	(0.34)	(0.32)	(0.48)
qe-euro	0.13*			
	(0.07)			
*qe-euro * bank-euro*	0.37***	0.07	0.10	0.06
	(0.12)	(0.14)	(0.10)	(0.16)
Firm*Bank F.E.	Yes	Yes	Yes	Yes
State*Industry*Period F.E.	No	Yes	Yes	–
Firm*Period F.E.	No	No	No	Yes
Firms borrowing from more than 1 bank	No	No	Yes	Yes
Observations	8,268,794	8,268,794	3,020,617	3,020,617
R^2	0.01	0.03	0.04	0.47

effects on lending in Mexico via U.S., U.K., and Eurozone banks respectively.[21] As for the nonstandard monetary policies, QE of the United States, the United Kingdom, and the Eurozone has a greater effect on the credit volume of firms whose loans are from U.S., U.K., or Eurozone banks respectively. In contrast, the Mexican policy rate affects the credit volume of all banks, regardless of their nationality. In other words, the overnight rate set by the Bank of Mexico affects banks operating in Mexico irrespective of whether they are Mexican. This may be because similar to domestically owned banks, foreign subsidiaries in Mexico have substantial local retail deposits and are therefore also affected by local monetary policy (see Table IA.II in the Internet Appendix).

To further control for time-varying unobserved borrower characteristics, in column (2) we saturate equation (1) with state*industry*period in addition to firm*bank fixed effects. The results from columns (1) and (2) suggest that even after controlling for these proxies for credit demand, the coefficients on monetary policy remain statistically and economically significant. As mentioned above, variation in a foreign monetary policy rate has a substantially greater effect on the banks of that origin. For example, focusing on column (2), a one-standard-deviation decrease in the Fed Funds rate raises the average loan volume of U.S. banks in Mexico by 6%, and a one-standard-deviation decrease in the monetary policy rate from the United Kingdom (Eurozone) expands credit by 4.8% (2%) on average.[22] It is important to stress that the coefficients in column (2) are better identified than those in column (1) as in addition to firm*bank fixed effects, we control for time-varying firm fundamental heterogeneity via state*industry*period fixed effects.

While the effect of QE on the supply of credit is not trivial, it is lower than that of standard monetary policy rates. For example, a one-standard-deviation expansion in the assets held by the Federal Reserve (relative to U.S. GDP) increases the volume of loans from U.S. banks by 2.6%. Similarly, a one-standard-deviation increase in the BoE's assets expands credit by 2.1%. In contrast, the QE of the Eurozone becomes statistically insignificant once we control for time-varying unobservables at the state and industry levels. This result highlights the fact that analyzing credit-supply outcomes with only bank-level data would be misleading as lenders are not matched exogenously with borrowers.[23]

In column (4) we saturate equation (1) with firm*month fixed effects (in addition to firm*bank effects) and focus on variation across loans offered by different

[21] Despite the numerous time-varying controls and the exogeneity of foreign monetary policy, Table IA.XII provides an additional robustness check of the exogeneity of the U.S. monetary policy. In that table, we instrument the Fed Funds rate (following the instruments suggested in Gertler and Karadi (2015)) for the period June 2001 to November 2009, which corresponds to the period in which the Fed Funds rate had not reached the zero lower bound. The results using the instrument of the U.S. policy rate are consistent with our findings. We thank Mark Gertler and Peter Karadi for sharing their data.

[22] Note that the standard deviations of interest rates and also of QE differ across countries (see Table I).

[23] However, we next show that monetary policy effects are stronger when the sovereign risk of the foreign country is lower, and hence the weak results of Eurozone banks in the crisis via QE reflects the higher financial risk. See also Table IA.XIV in the Internet Appendix.

banks to a given firm in a given month. However, this specification requires that firms hold loans from multiple banks in the same month, and such firms tend to be larger and, hence, may be differently affected by monetary policy shocks. Not surprisingly, we lose more than half of the observations and some coefficients lose statistical significance. To examine whether our coefficients change due to the sample selection, in column (3) we use the same specification as in column (2), but we restrict the sample to firms that in a given period have loans with more than one bank. As column (3) indicates, the coefficients that drop by half in column (4) do so because of the selection bias toward larger firms. Importantly, note that in column (4) the estimated coefficients are not statistically different from those of column (3) despite a substantial increase in the R^2 (around 43 percentage points). This suggests that our main coefficients on credit supply shocks (foreign banks and monetary policy) are exogenous to unobserved demand proxied by (firm*month) time-varying firm unobservables and observables (following Altonji, Elder, and Taber (2005)).

Panel B of Table IIB reports results on the effects of changes in monetary policies on the three other margins of loans—maturity, collateral, and interest rate—as well as future loan defaults. On average, a one-standard-deviation reduction in foreign monetary policy translates into loans that are not only larger, but also of longer maturity, and for U.S. banks, into lower interest rates.[24] While the supply of bank credit also increases with an expansion of foreign QE, its economic effect is lower and is concentrated on volume. Moreover, changes in U.S. QE have a larger effect than changes in U.K. or Eurozone QE, as it affects not only loan volume but also loan rate and maturity. More specifically, a one-standard-deviation increase in U.S. QE results in loans from U.S. banks that on average are 2.6% larger in volume, have 7.8% longer maturity, have no change on collateral, and have 0.3 percentage points lower interest rate.

Finally, in the last two columns we investigate if future loan defaults (the share of loans observed in default at t+12 months) are affected by the loosening of credit conditions in response to softer monetary policy.[25] The results suggest that in general, softer monetary policies abroad (standard and nonstandard) lead to higher future loan default rates of banks from the same country or region. Moreover, and as we show later, softer monetary policy induces banks to lend relatively more to firms with higher risk as proxied by higher ex ante loan rates, which also helps explain our result on defaults.[26]

[24] Moreover, a softening of foreign monetary policy increases collateral by 5.7%, which could be due to higher valuation of the collateralized assets when policy is softer. Our main results hold when we control for changes in collateral, that is, our results are robust to controlling for collateral as a right-hand-side variable (so even if collateral value is higher, the softening effects on the other loan outcomes are significant).

[25] Our measure of future default for the firm-bank pair at time t is the default rate of the firm-bank pair at t+12, or if the pair left our sample prior to t+12, the last observation available. In the empirical exercises involving the default rate at t+12 we only use data until December of 2014. In addition to t+12, we also studied the impact on default at t+6 and t+24. The results are qualitatively similar.

[26] As a robustness check, in Table IA.XV in the Internet Appendix, we also analyzed asymmetric monetary policy effects. We do not find statistically different results. In particular, most of the

Table IIB

Panel B Impact of International Monetary Policies on Other Domestic Credit Margins

This table reports the estimates from OLS regressions for the period June 2001 to December 2015. Observations are at the firm-bank-month level. The loan dependent variables (given by a bank in a month) are the firms' log loan maturity in months, collateral rate, loan rate and default in $t+12$ in a given month. *intrate-countryr* is the residual of policy rate of *country*, where *country* stands for United States, United Kingdom, Euro Area, or Mexico. *qe-country* is the ratio of the annual real change in central bank assets to GDP of *country*. *bank- country* is a dummy indicating whether bank headquarters are in *country*. Other controls are listed in Section II. Fixed effects already absorbed by other fixed effects are indicated by "-." Standard errors are reported in parentheses and are clustered at the period and bank-industry levels, where period is month. *,**,*** significant at the 10%, 5%, and 1% level, respectively.

	Loan Maturity		Loan Collateral		Loan Rate		Loan Default	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
*intrate-usr * bank-us*	−5.80***	−5.79***	−0.66***	−0.86***	0.16**	0.16***	−0.48*	−0.59**
	(1.60)	(1.63)	(0.18)	(0.22)	(0.09)	(0.05)	(0.28)	(0.28)
*intrate-ukr * bank-uk*	−9.17***	−8.63***	−0.98***	−0.85***	−0.01	0.01	−0.62**	−0.09
	(0.89)	(1.35)	(0.16)	(0.20)	(0.01)	(0.11)	(0.25)	(0.34)
*intrate-euror * bank-euro*	1.13	0.70	−1.95***	−2.16***	0.05	0.04	−0.61*	−0.59*
	(1.20)	(1.37)	(0.28)	(0.36)	(0.07)	(0.10)	(0.35)	(0.35)
*intrate-mexr * bank-mex*	2.35***	1.48*	−0.35*	−0.40	−0.06	−0.02	0.25	0.44
	(0.75)	(0.85)	(0.19)	(0.26)	(0.04)	(0.07)	(0.18)	(0.30)
*qe-us * bank-us*	2.64***	2.90***	0.08	0.07	−0.09***	−0.10**	0.13*	0.14*
	(0.82)	(0.87)	(0.12)	(0.14)	(0.03)	(0.04)	(0.07)	(0.08)
*qe-uk * bank-uk*	0.65	0.28	−0.08	−0.03	−0.01	0.01	0.18*	0.19
	(0.54)	(0.72)	(0.10)	(0.14)	(0.01)	(0.09)	(0.10)	(0.20)
*qe-euro * bank-euro*	−0.08	0.01	0.16**	0.12	0.03***	0.03**	0.05	0.09
	(0.26)	(0.28)	(0.07)	(0.09)	(0.01)	(0.01)	(0.07)	(0.11)
Firm*Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State*Industry*Period F.E.	Yes	–	Yes	–	Yes	–	Yes	–
Firm*Period F.E.	No	Yes	No	Yes	No	Yes	No	Yes
Firms borrowing from more than one bank	No	Yes	No	Yes	No	Yes	No	Yes
Observations	8,268,794	3,020,617	8,268,794	3,020,617	8,268,794	3,020,617	6,537,533	2,301,790
R^2	0.17	0.54	0.04	0.46	0.23	0.58	0.03	0.57

Table IIC

Panel C Impact of 3-Month to 12-Month Lagged International Monetary Policies on Domestic Credit Margins

This table reports the estimates from OLS regressions for the period June 2001 to December 2015. Observations are aggregated at the firm-bank-month level, where banks are classified as foreign or domestic. The loan dependent variables (given by a bank in a month) are a firm's total log loan volume with foreign (domestic) banks in a given month, average log maturity, collateral rate, loan interest rate, and default rate at $t+12$ with foreign (domestic) banks in a given month. Columns 3m lag, 6m lag, and 12m lag use the policy rates lagged by 3, 6, and 12 months, respectively. *intrate-fgnr* is the average residual of foreign overnight rates weighted by the firm's share of loans from United States, United Kingdom, or Eurozone banks. *intrate-mexr* is the residual of the Mexican overnight rate. *qe-fgn* is the average of foreign QEs weighted by the firm's share of loans from U.S., U.K., or Eurozone banks. *bank-fgn* is a dummy variable that equals one if the bank is headquartered in the U.S, U.K., or Eurozone. *bank-mex* is a dummy variable that equals 1 if the bank is headquartered in Mexico. All regressions include fixed effects at the firm*bank *(F*B)* and state-industry-period *(S*I*P)* levels. Other controls are listed in Section II. Standard errors are reported in parentheses and are clustered at the period and state-industry levels, where period is a month. *,**,*** significant at the 10%, 5%, and 1% level, respectively.

	Loan Volume			Loan Maturity			Loan Collateral			Loan Rate			Loan Default		
	3m lag (1)	6m lag (2)	12m lag (3)	3m lag (4)	6m lag (5)	12m lag (6)	3m lag (7)	6m lag (8)	12m lag (9)	3m lag (10)	6m lag (11)	12m lag (12)	3m lag (13)	6m lag (14)	12m lag (15)
intrate-fgnr	−1.46**	−1.81***	−2.05***	−4.81***	−4.72***	−4.29***	−1.09***	−1.25***	−1.34***	0.04	0.07*	0.20***	−0.49***	−0.49***	−0.26*
**bank-fgn*	(0.58)	(0.57)	(0.46)	(1.16)	(1.21)	(1.13)	(0.33)	(0.32)	(0.28)	(0.04)	(0.04)	(0.02)	(0.14)	(0.13)	(0.13)
intrate-mexr	0.06	0.50	0.25	2.50***	2.94***	3.41***	−0.79***	−0.34	0.71***	0.04	0.10**	0.06**	0.28	0.2	0.18
**bank-mex*	(0.34)	(0.40)	(0.28)	(0.84)	(0.82)	(0.89)	(0.26)	(0.25)	(0.20)	(0.04)	(0.04)	(0.02)	(0.21)	(0.17)	(0.17)
qe-fgn	0.31**	0.46***	0.50***	1.00***	1.35***	1.34***	0.17***	0.13**	0.08	0.01	0.01	0.01	0.03	0.05	0.21***
**bank-fgn*	(0.11)	(0.09)	(0.09)	(0.24)	(0.23)	(0.25)	(0.06)	(0.05)	(0.06)	(0.01)	(0.01)	(0.01)	(0.05)	(0.05)	(0.04)
F*B F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
S*I*P F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	7,046,918	7,046,918	7,046,918	7,046,918	7,046,918	7,046,918	7,046,918	7,046,918	7,046,918	7,046,918	7,046,918	7,046,918	5,196,351	5,196,351	5,196,351
R^2	0.03	0.03	0.03	0.13	0.13	0.13	0.04	0.04	0.04	0.18	0.18	0.19	0.03	0.03	0.03

Next, in Panel C, we analyze the sensitivity of changes in the various credit margins to the timing of the monetary policy. Here we classify banks as domestic or foreign, and we regress the different credit margins on different lags of foreign and domestic monetary policies (ranging from three to 24 months). Observations are still at the firm-bank-period level, but each firm has at most two observations per period depending on whether it has loans from domestic banks, foreign banks, or both.[27]

Our results suggest that, when the benchmark one-quarter-lagged foreign monetary policy rate declines by one standard deviation, loans from foreign banks increase their volume by 1.5%, lengthen their maturity by 4.8%, and increase collateral values by 4.6%. In addition, the impact of lagged foreign monetary policy on credit supply is somewhat persistent within a range of 3 to 12 months, and then declines after 12 months (not shown). The coefficients on loan volume, collateral, and interest rates achieve their maximum absolute value at 12-month lags, while maturity and the default rate are relatively less persistent. Regarding QE, the coefficients also increase at higher lags, especially for volume and defaults. Overall, for both types of monetary policy shocks, the speed of transmission becomes weaker after 12 to 15 months, and while there is some heterogeneity in the speed of transmission across loan margins in the first 12 months, the effects are generally stronger between 6 and 12 months for both monetary rates and QE.

A possible concern is that the results in Table II could be driven by the commercial characteristics of banks and not by the specificities of foreign monetary policies. To formally test for this possibility, we re-estimate Panel A of Table IIA, controlling for time-varying bank characteristics (in addition to bank*firm fixed effects) such as bank total size, liquidity and capital ratio. The results are reported in Table IA.XI in the Internet Appendix, and are not meaningfully affected by the introduction of these controls. Moreover, in Table IA.XIII we find similar results when we estimate only the loans of the five largest banks (four foreign and one Mexican bank). Another concern is that the results may be driven by a subset of customers. For example, U.K. banks may be serving firms that export to the United Kingdom. To control for this possibility, we rerun our regressions separately for exporters and nonexporters, where we classify firms by either (i) tradable versus nontradable industries, following Mian and Sufi (2014), or (ii) northern versus southern states, since the northern states in Mexico have substantially more economic relations with the United States. (INEGI (2014)) as well as a larger share of exports to GDP (39% compared to 12%). The results are reported in Tables IA.IX and IA.X in

coefficients on asymmetry are not significantly different from zero, though in a few cases, it may be due to lack of statistical power. One coefficient that is asymmetric is the impact of QE on loan defaults, which is entirely driven by the expansive monetary period.

[27] We construct the credit margins as follows. In each month, the loan volume that a firm obtains from foreign (domestic) banks is given as the sum of the outstanding loans that the firm has from all foreign (domestic) banks in the period. The other credit margins of loans from foreign (domestic) banks—maturity, collateral, and loan rate—as well as defaults correspond to their average weighted by loan volume.

the Internet Appendix, and show no difference between exporters and nonexporters with regard to the impact of foreign monetary policy on credit outcomes via foreign subsidiaries. This result is not surprising as the subsidiaries of foreign banks in Mexico are important across all sectors, as shown in Table IA.II in the Internet Appendix.

Finally, we use bank-level data to test whether our loan-level results are also present at a more aggregate level, and to further understand the economic mechanisms behind our findings. The results are presented in Table IA.VIII in the Internet Appendix. Columns (1) and (2) corroborate our loan-level results: when foreign monetary policy becomes more expansive, total assets and 1-year-ahead credit-in-arrears of foreign banks increase more. We find a similar pattern for changes in foreign QE. The next three columns provide insights into the economic mechanisms behind our results. Compared to domestic banks, foreign banks borrow substantially more, especially from abroad, when foreign monetary policy is softer. That is, compared to domestic banks, foreign banks obtain more funds from foreign markets when foreign monetary policy is softer. Furthermore, while not statistically significant, the economic magnitude of the coefficient capturing the effect of foreign monetary policy on short-term liabilities is very high (the coefficient is high and larger than on the other margins but with substantially higher standard errors), suggesting that foreign banks obtain more short-term funding when foreign monetary policy is softer.

Taken together, our results are consistent with foreign banks taking on more liquidity (partly from abroad) and credit risk (providing more credit and observing higher ex post defaults), and despite the fact that their liabilities are more fragile (foreign and partially of shorter term), these banks lend at longer maturities on the asset side (with higher credit volume and to riskier borrowers, as suggested by the higher ex post loan defaults, and as we will see in Section II.C, by lending to ex ante riskier borrowers).

B. Firm-Level Credit Supply Outcomes and Real Effects

To examine whether monetary policy shocks have real effects on firms, we need to analyze firm-period-level data by matching the credit register to firm balance sheet data. This allows us to investigate whether, for example, the total credit that firms obtain is affected by changes in foreign monetary policies. Importantly, when we restrict the analysis in the loan-level regressions to firms that borrowed from at least two banks in a given period, the estimated effects of monetary policy remained relatively unchanged (see, e.g., the comparison of columns (3) and (4) of Table IIA, Panel A). Therefore, firm and state*industry*period fixed effects in firm-level data provide sufficient controls for unobserved borrowers, which allows us to identify the bank credit supply channel at the firm level.

The first five columns of Table III present results of our bank credit outcomes for the firm-year-level data. We find that, on average, firms with a higher lagged share of bank credit from foreign banks are more affected by the monetary policy in these countries. For example, for firms whose total bank credit was

Table III

Impact of International Monetary Policy on Domestic Firm-Level Real Effects and Credit Outcomes

This table reports the estimates from OLS regressions for the period 2001 to 2015. Observations are aggregated at the firm-year level. The first six columns use information from the loan-level data set and refer to a firm's loan volume in logs, maturity in logs, collateral rate, loan interest rate, and 1-year-ahead default rate as well as a proxy for firm survival. The last six columns restrict the sample to firms that are observed in both the loan-level data set and in the Orbis data set. The dependent variables are a firm's log liabilities (total, current, noncurrent), log assets (total and fixed), and employment in a given year. *intrate^{Y}-fgnr* is the annual average of the residual of foreign overnight rates weighted by the firm's share of loans from U.S., U.K., or Eurozone banks. *share^{Y}-fgn* is the 1-year-lagged share of a firm's debt with foreign banks. *intrate^{Y}-mexr* is the residual of the Mexican overnight rate. *share^{Y}- mex* is a firm's 1-year-lagged-share of loans from Mexican banks. *qe^{Y}-fgn* is the average of foreign QE weighted by the firm's share of loans from U.S., U.K., or Eurozone banks. *share^{Y}-fgn* is the 1-year-lagged share of a firm's bank debt from foreign banks. All regressions include fixed effects at the firm and state*industry*year level. Standard errors are reported in parentheses and are clustered at the state*year level. *,**,*** significant at the 10%, 5%, and 1% level, respectively.

	Credit Volume (1)	Credit Maturity (2)	Credit Collateral (3)	Credit Rate (4)	Credit Default (5)	Exit (6)	Liabilities (7)	Current Liabilities (8)	Noncurrent Liabilities (9)	Assets (10)	Fixed Assets (11)	Employment (12)
*intrate^{Y}-fgnr*share^{Y}-fgn*	−1.54*	−4.92**	−1.32**	0.12*	−0.32*	0.92*	−1.20**	−1.26***	−2.08**	−0.76*	−0.45*	−0.34*
	(0.89)	(1.88)	(0.52)	(0.07)	(0.19)	(0.54)	(0.40)	(0.38)	(0.65)	(0.39)	(0.25)	(0.20)
*intrate^{Y}-mexr*share^{Y}-mex*	3.28*	4.37	0.16	−0.02	0.05	−0.22	0.43	0.93	−1.23	0.85**	1.19***	0.27
	(1.83)	(3.85)	(2.23)	(0.10)	(0.68)	(0.70)	(0.69)	(0.61)	(2.88)	(0.31)	(0.15)	(0.57)
*qe^{Y}-fgn*share^{Y}-fgn*	0.24	0.95	0.39**	0.03	0.14*	0.02	0.20	0.09	0.43	0.15	0.68***	−0.06
	(0.31)	(0.96)	(0.18)	(0.04)	(0.08)	(0.10)	(0.16)	(0.20)	(0.40)	(0.15)	(0.12)	(0.12)
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State*Industry*Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	747,910	747,910	747,910	747,910	735,240	747,913	13,918	13,918	13,918	14,563	14,563	13,838
R^2	0.09	0.14	0.04	0.17	0.03	0.04	0.20	0.20	0.25	0.26	0.22	0.19

with foreign banks in the previous year, a one-standard-deviation reduction in the *intrate*^{Y}*-fgn* in the current year leads to an increase in loan volume of 1.5%, a rise in maturity and collateral of 4.9% and 4.8%, respectively, and a decline of 0.8% in interest rate. With respect to loan default (delinquencies), a one-standard-deviation reduction in *intrate*^{Y}*-fgn* increases loan default by 5.3%. Finally, the impact of the average nonstandard monetary policy at the firm-level is generally not statistically significant, except for collateral and default, but the lack of significance is due in part to higher standard errors.

There are also significant real effects. On the extensive margin, a one-standard-deviation reduction in *intrate*^{Y}*-fgn* reduces firm exit due to loan defaults by 1%. The final six columns display the results for the intensive margin for firm-level variables obtained from Orbis. For total liabilities, assets, fixed-assets, and employment, we find that foreign monetary policy shocks have real effects on firms (columns (7) to (12)). For instance, total firm liabilities (including bank credit) increase by 1.2% when the average foreign monetary policy declines by one standard deviation in a given year, while fixed assets (i.e., net investment) rise by 0.5%.[28] Employment also increases, but by only 0.3%. Note that, since with this data set we have only a few annual observations for each firm after the QE period started, our results for the impact of nonstandard monetary policies on real outcomes could lack statistical power (e.g., for loan outcomes, all QE results are statistically significant in the monthly level data).[29] Moreover, we analyze whether the effect of the monetary policy depends on firm size. To do so, we re-estimate equation (2) interacting the monetary policies with an indicator for small firms with fewer than 50 employees (following Beck and Demirguc-Kunt (2006)). The results are displayed in Table IA.XIX in the Internet Appendix, and indicate that the effects are indeed stronger for smaller firms, while nonexistent for large firms. Therefore, given the somewhat overrepresentation of large firms in Orbis (see Table IA.V in the Internet Appendix), our results for the firm balance sheet variables suggest a lower bound on the real effects.

A possible concern regarding the relatively subdued effect of QE on the majority of the results is that this unconventional policy is highly correlated with periods of high risk and uncertainty, such as those observed after the global financial crisis, in which case the results may be biased toward zero given the positive correlation between the QE measures and various measures of financial risk. To test for this possibility, we interact our QE measure with the sovereign CDS of the country. The results, presented in Table IA.XIV in the

[28] We analyze net, not gross, investment, which is common in the literature. See, for example, Lang, Ofek, and Stulz (1996). If investment expenditures just match the depreciation of capital equipment, then gross investment rises, but net investment is unchanged. Higher net investment, not gross, is what matters for overall productivity, and it is computed as the annual change in fixed tangible assets. Note also that the effects are larger for bank credit than for total liabilities and assets (Table IA.XVIII in the Internet Appendix shows that the results do not depend on the scale of the different firm variables).

[29] See Tables IA.XVI and IA.XVII in the Internet Appendix for different lags of monetary policy on firm outcomes.

Internet Appendix, show that the QE results are indeed stronger the lower is the CDS of the sovereign where the foreign bank is headquartered. This may explain why for some results, elasticities for QE are lower than those for interest rates, especially for the Eurozone banks given the Eurozone crisis. In sum, when the Federal Reserve, the ECB, and the BoE expand their balance sheet via nonstandard monetary policies, the U.S. and European banks expand into Mexico less, the higher is the risk in the countries where their parent banks are located.

C. Reach-for-Yield and Risk-Taking Channel of Monetary Policy

To further understand the risk-taking behavior of banks, and to determine whether they engage in ex ante *reach-for-yield*, we examine whether credit terms are more likely to change for firms with higher ex ante loan interest rates, which tend to have higher ex post default rates (see Table IA.III in the Internet Appendix). To do so, in each period we calculate the average interest rate charged by banks to all firms (firm-bank observations weighted by loan volume). We then separate our sample into two groups depending on whether their ex ante cost of credit is above or below this average cost, and rerun equation (1) separately for these two samples of firms. The results are presented in Table IV.

Results indicate that, on average, foreign banks soften lending conditions more to firms with a higher ex ante interest rate when foreign monetary policy is relaxed. These effects operate in the same direction for the different lending margins and imply higher future loan defaults. In the first two columns of Table IV, we find that a one-standard-deviation decrease in foreign monetary policy increases loan volume for the high-yield group by 5% on average, and in the low-yield group by only 1.3%. The effects are large for U.S., U.K., and Eurozone banks. Similarly, a one-standard-deviation increase in QE increases loan volume of high-yield firms by around 1.5% but has no statistically significant effect on the sample of low-yield firms.[30]

Loan maturity (which proxies for liquidity risk) is the credit margin through which high-yield firms (which proxy for credit risk) benefit relatively more from an expansion in monetary policies. As columns (3) and (4) indicate, a one-standard-deviation reduction in the average foreign interest rate lengthens the average loan maturity by 10% for high-yield firms, whereas its effect is negligible among low-yield firms. We also find that on average foreign QE has a stronger, albeit smaller, effect on low-yield firms. In addition, while banks extend on average larger and longer loans to riskier firms when foreign monetary policy expands, the value of collateral requirements increases, possibly due to valuation effects (columns (5) and (6)). Regarding loan rates, columns (7) and (8) show that in general, interest rates from

[30] For QE, effects are not significant for Eurozone banks, except for higher ex post loan defaults. Note that these banks were more affected by higher CDSs of their sovereign, which mitigate the effect of QE on loan margins.

Table IV

Impact of International Monetary Policies on Domestic Credit Margins by Ex Ante Loan Rates

This table reports the estimates from OLS for the period June 2001 to December 2015. Observations are at the firm-bank-month level. A firm-bank-period observation is high (low) yield if the interest rate it pays on its loans is above (below) the average loan interest rate, weighted by loan volume, paid by all firms in the previous quarter for all loans. The dependent variables are a firm's log loan volume, log maturity in months, collateral rate, loan rate, and future default rate (at period $t+12$) with a given bank in a given month. *intrate-countryr* is the residual policy rate of *country*, where *country* stands for United States, United Kingdom, Euro Area, or Mexico. *qe-country* is the ratio of the annual real change in central bank assets to GDP of *country*. *bank-country* is a dummy indicating whether the bank's headquarters are in *country*. Other controls are listed in Section II. Standard errors clustered at the period and bank-industry levels are reported in parentheses, where period is month. *,**,*** significant at the 10%, 5%, and 1% level, respectively.

	Loan Volume		Loan Maturity		Loan Collateral		Loan Rate		Loan Default	
	High yield (1)	Low yield (2)	High yield (3)	Low yield (4)	High yield (5)	Low yield (6)	High yield (7)	Low yield (8)	High yield (9)	Low yield (10)
intrate-usr bank-us*	−3.92***	−2.28***	−6.46***	−0.89**	−0.59***	−1.40***	0.20***	0.02	−0.59*	0.58**
	(0.43)	(0.69)	(1.78)	(0.45)	(0.15)	(0.42)	(0.03)	(0.04)	(0.35)	(0.26)
intrate-ukr bank-uk*	−2.75***	−0.34	−9.47***	0.22	−1.08***	−0.82*	0.02	0.01	−0.55*	0.19
	(0.59)	(0.87)	(1.00)	(0.52)	(0.15)	(0.48)	(0.08)	(0.10)	(0.29)	(0.33)
intrate-euror bank- euro*	−2.51**	−1.04	1.36	2.35***	−2.31***	−0.71	0.15*	0.04	−0.35	−0.24
	(1.13)	(1.14)	(1.33)	(0.61)	(0.30)	(0.54)	(0.09)	(0.06)	(0.53)	(0.52)
intrate-mexr bank-mex*	0.80*	1.23	2.72***	−0.21	−0.32	0.01	−0.10*	−0.06	0.20	0.21
	(0.45)	(0.75)	(0.76)	(0.69)	(0.21)	(0.42)	(0.06)	(0.06)	(0.20)	(0.18)
qe-us bank-us*	0.94***	0.49	3.08***	0.44	0.15	−0.70*	−0.10**	0.02	0.20***	−0.02
	(0.28)	(0.31)	(0.84)	(0.28)	(0.09)	(0.37)	(0.04)	(0.02)	(0.07)	(0.11)
qe-uk bank-uk*	0.70*	0.03	0.74	−0.73	−0.07	0.22	−0.01	−0.02	0.20*	0.22
	(0.38)	(0.40)	(0.58)	(0.48)	(0.08)	(0.44)	(0.05)	(0.07)	(0.10)	(0.24)
qe-euro bank-euro*	0.01	−0.24	−0.13	0.45***	0.10*	0.26	0.04***	0.01	0.13**	0.06
	(0.12)	(0.17)	(0.27)	(0.13)	(0.06)	(0.17)	(0.01)	(0.01)	(0.07)	(0.07)
Firm*Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State*Industry*Period F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,110,956	1,157,838	7,110,956	1,157,838	7,110,956	1,157,838	7,110,956	1,157,838	5,602,833	934,700
R^2	0.03	0.09	0.21	0.08	0.04	0.10	0.25	0.29	0.03	0.10

high-yield firms respond in the direction of the changes to foreign monetary policy, whereas low-yield firms do not. On average, a one-standard-deviation reduction of foreign monetary policy translates into a 1.1% reduction in the average loan rate of high-yield firms. As with other credit margins, interest rates of loans are also influenced by changes in QE. Our results suggest that a one-standard-deviation increase in U.S. QE translates into a 0.3 percentage point reduction in the average loan rate on loans for high-yield firms.

Focusing on future default, in columns (9) and (10), we also find that the effect of a loosening of credit conditions on future default is concentrated among firms with high yield. In particular, default rates are more responsive to changes in monetary policy from the United States and the United Kingdom (both standard and nonstandard) and from the Eurozone (mainly nonstandard). For instance, a reduction of one standard deviation in the foreign interest rate increases the average default for high-yield firms by 11.7% and has no significant impact for low-yield firms. Similarly, the expansion in QE increases the incidence of default. Changes in foreign QE are associated on average with an 8.6% increase in the share of bank credit in default among high-yield firms.

Taken together, the increase in credit supply due to low foreign monetary policy rates and expansive QE is stronger for borrowers with higher ex ante loan rates, which proxy for reaching-for-yield, and with higher ex post loan defaults, and thus suggests an international risk-taking channel of monetary policy. Quantitatively, these effects are large.

III. Conclusions

We analyze the international bank lending and risk-taking channel of monetary policy rates and QE through foreign banks. We analyze foreign banks, as in addition to being affected by their own country's monetary policy, these banks are important both around the world, and in emerging markets, where they account for approximately 50% of the market share. Despite the importance of these questions for both public policy (notably, central banking policies and international monetary and financial coordination) and academia (international macro-finance), identification of the international channel of monetary policy has not been possible due to the lack of comprehensive credit registry data matched with firm and bank information. As we stress in the introduction, the empirical literature on the international risk-taking and credit channel of monetary policy has mainly focused on macro- or bank-level data. We overcome this hurdle by analyzing the case of Mexico, an ideal empirical setting for identification given the exhaustive micro data sets (credit register matched to firm- and bank-level data) as well as given the important presence of foreign banks.

We use the supervisory data set that contains information on all business loans in Mexico, including interest rates, which are absent from most credit registers around the world, while exploiting foreign monetary policy

shocks, both standard policy rate and nonstandard QE. Loan-level data are crucial to identify credit supply (and risk-taking), as foreign banks may lend to different types of firms, and matched firm-credit level data are needed to measure the associated real effects of the credit channel of monetary policy.

Robust results suggest that a softening of foreign monetary policy increases the supply of credit by foreign banks to Mexican firms. Each regional policy shock mainly affects supply via the region's respective foreign banks. That is, U.S., U.K., and Eurozone monetary policy mainly affects credit supply to Mexican firms via U.S., U.K., and Eurozone banks in Mexico, respectively. All loan terms are affected, but effects are substantially weaker for loan rates. Moreover, the international monetary policy channel implies strong real effects, with much stronger elasticities on monetary rates than QE. Finally, low foreign monetary policy rates and an expansion in QE lead to higher credit supply by foreign banks for borrowers with higher ex ante loan rates (reaching-for-yield), with substantially higher ex post loan defaults, thus suggesting an international risk-taking channel of monetary policy.

In sum, the results suggest spillovers of core countries' monetary policies into emerging markets, both in the foreign monetary softening part (with not only higher credit risk taken by foreign banks, but also higher liquidity risk stemming from higher foreign funding) and in the tightening part (with the negative associated local real effects in terms of lower firm-level total assets, net investment, employment, and survival).

Importantly, not only is foreign monetary policy key to analyzing the international channel and to obtaining exogenous variation of monetary policy, as compared to local policy, but it is not determined by local economic conditions of emerging markets. This implies that a change in foreign policy can be further destabilizing, especially given the foreign bank channel that we document in this paper. Indeed the results are consistent with some claims by, among others, Reserve Bank of India Governor Raghuram Rajan (2014) and Helene Rey (2013) on the effects of core countries' monetary policies on emerging markets' economies, and thus suggest a need for more coordinated global monetary policy, for example, at the G-20 level with both high income and emerging countries, or the use of local prudential policies in emerging markets. Hence, a fruitful avenue for future research, apart from analyzing the external (international) versus internal (local) spillovers of monetary policy, is whether local macroprudential policies can reduce, or even neutralize, the foreign spillovers into emerging markets stemming from foreign monetary policy in core economic areas, or whether global coordination of monetary policies is the only solution.

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Appendix

Table A.I
Variable Definitions (Loan-Month Level)

loan volume	Value of the outstanding loans that a firm has from a given bank in a given month (thousands of Mexican pesos).
loan maturity	Average maturity (in months) of the outstanding loans that a firm has from a given bank in a given month, weighted by loan volume.
loan collateral	Average fraction of the outstanding loans that a firm has from a given bank in a given month that is covered by the firms' assets, weighted by loan volume.
loan rate	Average annualized loan rate of the outstanding loans that a firm has from a given bank in a given month, weighted by loan volume.
loan default	Average fraction of the outstanding loans that a firm has from a given bank in a given month that have been delinquent for at least 90 days, weighted by loan volume.
intrate-us	Fed Funds rate.
intrate-uk	SONIA rate.
intrate-euro	EONIA rate.
intrate-mex	Mexican overnight interest rate (*Tasa de Fondeo Interbancaria*).
intrate-usr	Residual from regression of the Fed Funds rate on the annual growth rate of real GDP-U.S. and CPI-U.S.
intrate-ukr	Residual from regression of the SONIA rate on the annual growth rate of real GDP-U.K. and CPI-U.K.
intrate-euror	Residual from regression of the EONIA rate on the annual growth rate of real GDP-Eurozone and CPI- Eurozone.
intrate-fgnr	Average policy rate residuals of U.K., U.S., and Eurozone weighted by the firm's loan volume from each geographical region.
intrate-mexr	Residual from regression of Mexican overnight interest rate on the Fed Funds rate and the annual growth rate of real GDP-mex, real GDP-U.S., CPI-mex, and CPI-U.S.
qe-us	Ratio of the annual real change in the Federal Reserve's balance sheet assets to U.S. GDP.
qe-uk	Ratio of the annual real change in the BoE's balance sheet assets to U.K. GDP.
qe-euro	Ratio of the annual real change in the ECB's balance sheet assets to Eurozone GDP.
qe-fgn	Average QE of the U.S., U.K. and Eurozone areas weighted by firm's loan volume from each geographical region.
bank-country	Indicator variable that equals one if the bank is headquartered in *country*, where *country* is U.S., U.K., Eurozone, or Mexico.
gdp-*country*	Seasonally adjusted real GDP annual growth of *country*, where *country* is U.S., U.K., Eurozone, or Mexico.
cpi-*country*	CPI annual growth of *country*, where *country* is U.S., U.K., Eurozone, or Mexico.
cds-*country*	Sovereign credit default swaps (CDS) of *country*, where *country* is U.S., U.K., or Eurozone.

Note: All *intrate-country* and *qe-country* variables are lagged one-quarter.

Table A.II
Variable Definitions (Firm-Year Level)

loan volume^{Y}	Value of the outstanding loans that a firm has from a given bank in a given year (thousands of Mexican pesos).
loan maturity^{Y}	Average maturity (in months) of the outstanding loans that a firm has from a given bank in a given year, weighted by loan volume.
loan collateral^{Y}	Average fraction of the outstanding loans that a firm has from a given bank in a given year that is covered by the firms' assets, weighted by loan volume.
loan rate^{Y}	Average annualized loan rate of the outstanding loans that a firm has from a given bank in a given year, weighted by loan volume.
loan default^{Y}	Average fraction of the outstanding loans that a firm has from a given bank in a given year that are more than 90 days in arrears, weighted by loan volume.
exit^{Y}	Proxy for firm survival due to loan defaults. Indicator variable that equals one if a firm in default exits permanently from the loan-level data set in a given year.
intrate^{Y}*-fgnr * share*^{Y}*-fgn*	Average annual residuals of monetary policies, weighted by the firm's loan volume from each geographical region, times the 1-year-lagged share of a firm's loans with foreign banks.
intrate^{Y}*-mexr * share*^{Y}*-mex*	Residual of regression of annual overnight Mexican interest rate on Fed Funds rate, GDP-mex, GDP-us, CPI-mex, CPI-us times the 1-year-lagged share of a firm's loans from Mexican banks.
qe^{Y}*-fgn * share*^{Y}*-fgn*	Average annual QE, weighted by the firm's loan volume from each geographical region, times the 1-year-lagged share of a firm's loans from foreign banks.
Variables from Orbis	
assets^{Y}	Total firm assets (thousands of Mexican pesos) in a given year.
fixed assets^{Y}	Total fixed-assets of a firm (thousands of Mexican pesos) in a given year.
liabilities^{Y}	Total liabilities of a firm (thousands of Mexican pesos) in a given year.
noncurrent liabilities^{Y}	Liabilities of a firm in a given year with a maturity over 12 months (thousands of Mexican pesos).
current liabilities^{Y}	Liabilities of a firm in a given year with a maturity under 12 months (thousands of Mexican pesos).
employment^{Y}	Total number of employees of a firm in a given year.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Appendix S1: Internet Appendix.
Disclosure Statements.