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Abstract

How does a bank react when a substantial share of its borrowers suffer a large negative shock? To answer this question we exploit the 2014 collapse of energy prices using the universe of Mexican commercial bank loans. We show that, after the drop in energy prices, banks exposed to the energy sector increased their exposure to these borrowers even more, relaxing credit margins to their larger debtors in the sector. An increase of one standard deviation in a bank's ex-ante exposure to the energy sector increased the loan volume to borrowers in the sector by 18 percent and reduced interest rates by 6 percent, even though borrower's credit default swap spreads were widening. Highly exposed banks amplified this sector-specific shock to the rest of the economy by contracting lending to other sectors, with important real effects, as the borrowers could not switch credit suppliers. Finally, the energy price shock had a large negative impact on macro outcomes, especially in the capital-intensive secondary sector. Quantitatively, a one standard deviation increase in the exposure of a state's banks to the energy sector reduced its GDP by 1.8 percent.

JEL codes: E52, E58, G01, G21, G28

Keywords: Credit exposure, bank lending, financial stability, commodity prices, emerging markets

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1. Introduction

Risk concentration has been a driver of major banking crises around the world (Acharya and Steffen 2015; Brunnermeier 2009; Westernhagen et al. 2004), forcing regulators to continuously monitor bank exposures to concentrated risks (FSI 2019). However, although regulation considers exposures to single and financially connected counterparties, there is limited knowledge on the strategies that banks adopt when their counterparties face a common negative shock, like a sectoral shock.[1] On the one hand, banks may scale back their lending to the impacted sector to reduce their losses and possibly diversify their loan portfolios. On the other hand, the actions taken by banks may depend on the bargaining power of their borrowers (Rajan 1992; Santos and Winton 2019). More exposed banks may be forced to expand their lending to the struggling sector, especially to their largest borrowers, to contain losses and preserve their regulatory capital ratios. In this latter scenario, risk concentration may trigger a credit channel whereby banks inject even more credit to borrowers in a troubled industry, reducing credit to other sectors in the economy. This not only leads to a misallocation of resources away from productive borrowers, but also raises the risk of financial stress, given the increased concentration in a weak segment of the economy.

Theoretical studies have stressed the trade-offs faced by banks in their portfolio choices. Although portfolio diversification allows banks to enhance their credit monitoring reputation (Diamond 1984; Boyd and Prescott 1986), bank specialization may provide better bank performance under certain circumstances (Winton 1999). The empirical literature has been mixed on this question. Some studies have stressed the aggregate benefits of bank specialization on systemic risks (Beck, De Jonghe, and Mulier 2017) and its benefits for borrowers with close bank relations (De Jonghe et al. 2019). In contrast, other studies have noted how shocks to specialized banks may affect credit provision (Paravisini, Schnabl, and Rappoport 2017) and how geographic diversification reduces bank risk (Goetz, Laeven, and Levine 2016).

To test these tradeoffs and shed some light on the mixed results, we analyze the impact of a negative energy price shock on the supply of credit, as the degree of banks' exposure to this

[1] For example, when prices in the energy sector collapsed in March of 2020 the *Financial Times* wrote that "investors are confronted with the alarming possibility that a collapse in oil prices could trigger a wave of defaults by borrowers. […] U.S. bank shares had their worst single-session performance since 2009 and the industry was a big contributor to a global stock market rout."

sector varies. In particular, we study the collapse of global energy prices in late 2014 and its effect on the Mexican energy sector. Although the price drop was driven by factors external to Mexico, the credit risk of Mexican firms operating in energy-related sectors ramped up as a result.[2] Importantly, the degree of Mexican banks' exposure to the energy sector varied substantially before the shock. We exploit this cross-bank variation to identify how banks reallocated their credit depending on their ex-ante exposure to the struggling sector. We show that banks with large exposures to the energy sector had an incentive to maintain borrowers afloat even as their creditworthiness deteriorated, causing a decline in lending to other sectors (Caballero, Hoshi, and Kashyap 2008; Peek and Rosengren 2005).

In addition, we test how banks transmit this type of shock to other sectors of the economy, which remains an important issue in finance. There are several challenges to answer these questions rigorously. One challenge is having a credible counterfactual, since aggregate shocks may affect the entire banking sector simultaneously. To overcome this hurdle, we exploit the late 2014 oil price shock and adopt a difference-in-differences approach with ex-ante similar banks differing in their exposure to energy-related sectors prior to the shock. We define ex-ante bank exposure as the ratio of loans to firms in energy-related sectors over the bank's tier 1 capital in the month prior to the unanticipated shock.[3]

A second challenge in identifying banks' strategies is to isolate changes in the supply of credit from changes in the demand for credit, as aggregate shocks might impact firms' credit needs. To control for time-varying credit demand, we rely on loan-level data obtained from the Mexican credit registry on the universe of commercial bank loans from January 2013 to June 2016. Loan-level data allow us to saturate our specifications with bank*firm and firm*month fixed effects, exploiting variation in the credit conditions of a firm-bank pair over time, as well as by the same

[2] The global energy price drop was related to the advent of new oil suppliers, such as shale producers in the United States (World Bank 2018). Figure 1 shows the rapid drop of West Texas Intermediate prices from almost $100 per barrel in mid-2014 to about $50 per barrel over just a few months. This drop was associated with a weakening of the creditworthiness of energy companies in Mexico and other emerging markets, as shown by the increase in their credit default swap premiums.

[3] Our measure of exposure follows the definition of credit exposure outlined by the Basel Committee on Banking Supervision (2014). As a robustness check, we use four alternative bank-level measures of ex-ante exposure and confirm that our findings remain unchanged. These measures are (i) August 2014 ratio of energy sector loans to total loans, (ii) August 2014 ratio of energy sector loans to total assets, (iii) August 2014 ratio of energy sector loans to total bank equity, and (iv) December 2012 ratio of energy sector loans to tier 1 capital (Table A4 in the appendix).

firm across different banks with varying exposures to the shock (Khwaja and Mian 2008; Morais et al. 2019).

Turning to the specific tests, we first use bank-level data to investigate the impact that larger exposure to the energy sector had on banks' balance sheet outcomes and risk dynamics after the shock. We then use the loan-level data to examine separately the lending dynamics of firms in energy-related sectors and all other sectors. Focusing first on borrowers in energy-related sectors, we examine changes in the value and terms of their loans across banks after the shock. Our outcomes of interest include the total amount of credit borrowed by energy firms, as well as the amount borrowed to finance working capital and investment projects. Other outcomes we analyze include interest rates, collateral rates, and loan maturities. To investigate whether banks transmit this sector-specific shock to other sectors, we compare lending to non-energy firms by banks with different degrees of exposure to the energy sector before and after the energy price shock.

Since firms may switch to other financing sources to smooth bank credit shocks, we complement our loan-level data with firms' yearly balance sheet information. The firm-level data allow us to identify whether shocks that affect the credit conditions of firms also affect their real outcomes. In addition, we investigate whether the states with more exposed banks had a sharper slowdown. We use quarterly gross domestic product (GDP) data for Mexican states and construct a state-level measure of exposure to the energy sector of the banks operating in the state.

We find that banks with greater ex-ante exposure to the energy sector significantly expanded their ex post lending to firms in the sector. This expansion took the form of larger loans for working capital at lower interest rates, suggesting that banks attempted to keep stressed firms afloat and their own capital ratios intact. For instance, an increase of one standard deviation in ex-ante exposure to the energy sector (relative to the bank's tier 1 capital) is associated with an increase of 1.2 percentage points in ex post exposure to the sector, an 18 percent increase in the size of loans to firms in the energy sector, and a 0.8 percentage point (roughly 6 percent) decrease in the interest rate. Consistent with a hold-up problem, these economically important magnitudes are concentrated among larger energy firms with which banks have greater exposures. This strategy was associated with a substantial increase in the risk taken by more exposed banks. An increase of one standard deviation in exposure to the energy sector results in 10.1 percent higher credit default swap (CDS) spreads, 3.1 percent lower stock prices, and 0.16 percentage point (roughly 8 percent) higher delinquency rates in the following quarters.[4]

The injection of credit to the energy sector did not result in an increase in total bank lending, as credit was redirected from firms in other sectors. The loan-level analysis reveals that the credit contraction among non-energy borrowers was stronger among smaller firms and especially for loans destined to investment projects. An increase of one standard deviation in ex-ante bank exposure leads to a 16.5 percent reduction in credit to smaller firms.[5]

We also find significant negative real effects on the activities of non-energy firms as a result of the contraction of bank credit. Non-energy firms headquartered in municipalities where banks had higher ex-ante exposure to the energy sector experienced a decrease in liabilities, investment, and assets after the energy price shock. An increase of one standard deviation in a municipality's exposure to the energy sector (via its bank branches) leads to a reduction in total liabilities of 2.9 percent and a reduction in assets of 2.6 percent. At a more aggregate level, we find that, compared with energy-producing states, the GDP of non-energy-producing states that were more exposed to the energy sector (via their banks) contracted more during the energy price shock, especially in the capital-intensive secondary sector (Buera, Kaboski, and Shin 2011). An increase of one standard deviation in the exposure of a state's banks to the energy sector reduces the state's total GDP by 1.8 percent. We interpret these findings as evidence of a credit channel, whereby banks amplified a sector-specific shock by contracting their lending to non-energy borrowers, which in turn struggled to switch lenders and smooth the shock.

Our findings suggest that risk concentration, or specialization, can amplify negative shocks. This is particularly relevant if banks need to provide additional credit to an ailing sector. Not only do bank exposures become riskier, but also banks must curtail credit from other areas of the economy, reducing the performance of nonaffected firms. Although regulations could prevent

[4] We also test whether in the post-shock period banks' nonperforming loans increased or capital levels decreased. This would point to the energy shock affecting the creditworthiness of Mexican banks. However, we do not find any significant relation between banks' exposure to the energy sector and measures of bank solvency. Alternatively, the banks may have extended lending to creditworthy energy firms that were only facing a transitory shock. However, this is not consistent with the steep increase in CDS premiums shown in Figure 1.

[5] These findings are consistent with Bidder, Krainer, and Shapiro (2017), who also find that, in response to the 2014 energy price collapse, U.S. banks did not change the overall size of their credit portfolio, but they reduced the risk of their portfolio.

these types of concentrated exposures, supervision may play a better role. Given the mixed evidence on the effects of specialized portfolios, supervisors should not only limit the risks of concentrated sectoral exposures, but also estimate the likelihood that those sectors may suffer from any shocks. This is particularly relevant for commodity sectors where price fluctuations are sharp and frequent and have a strong correlated impact on all firms in the industry.

Our paper relates to several literatures. First, it contributes to the literature studying the relationship between bank diversification and performance. Diamond (1984) argues that as banks increase diversification, their vulnerability to economic downturns and risk of default drops. However, recent empirical studies find that diversification is negatively associated with banks' returns and monitoring effectiveness, while positively related to their risk (Acharya, Hasan, and Saunders 2006; Laeven and Levine 2007; Berger, Hasan, and Zhou 2010; Tabak, Fazio, and Cajueiro 2011). Our paper complements this empirical literature by exploiting an exogenous shock to commodity prices to identify the costs that may stem from banks' high sectoral exposures.

Second, we complement the extensive literature studying the negative effects that volatile commodity price shocks have on financial markets and economic growth (Agarwal, Duttagupta, and Presbitero 2019; Blanchard and Gali 2010; Bruckner and Ciccone 2010; Alesina, Campante, and Tabellini 2008; Dehn 2000; Kinda, Mlachila, and Ouedraogo 2016; Deaton 1999; Deaton and Miller 1996). We contribute to this literature by documenting that banks amplify commodity price shocks via the credit channel.

Last, we contribute to the literature studying the effects of liquidity shocks on bank lending. This literature has traditionally examined how banks transmit shocks to the real sector via changes in their credit supply, by exploiting changes in the domestic monetary policy (Kashyap and Stein 2000), local liquidity shocks (Gilje, Loutskina, and Strahan 2016; Khwaja and Mian 2008; Iyer and Peydro 2011), and global liquidity shocks (Schnabl 2012; Morais et al. 2019; De Jonhge et al. 2019; Ippolito et al. 2016). Different from these papers, we examine a liquidity shock that has not been as widely explored. The shock we examine works through troubled borrowers' demand for short-term funding and its effects on the asset side of banks' balance sheets instead of their liabilities.

The rest of the paper is organized as follows. Section 2 describes the data used in the analysis. Section 3 discusses the empirical strategy we follow. The results are summarized in section 4. Finally, section 5 concludes.

2. Data

We use data from three main sources, covering January 2013 to June 2016. The first data set, which we refer to as the loan-level data, consists of the universe of commercial loans in Mexico, which we obtained from regulatory reports sent monthly by every commercial bank to the bank regulator. The reports are mandatory, updated electronically, and include detailed characteristics of all new and continuing commercial loans. All loans, regardless of their size, are reported. Each loan has an identifier of the issuing bank, as well as the borrower's identifier, location, sector, and number of employees. The data set includes information on the interest rate, outstanding amount, type of financing (i.e., whether the loan is for working capital or investment purposes), and start and end dates (maturity) of each loan. Given that some borrowers have more than one loan issued by the same bank at a given point in time, we adopt a similar approach as La Porta et al. (2003) and aggregate individual loans at the *firm-bank-month* level. We then report loan characteristics, such as the interest rate, fraction of the loan covered by collateral, and maturity at origination, using a weighted average by loan value. This approach puts greater weight on larger loans, ensuring that our results are economically meaningful.

Our second data source is Orbis, a *firm-year*-level data set compiled by Bureau van Dijk, which contains information on the balance sheets and income statements of a large set of Mexican firms. The data set reports information on assets and revenues of firms as well as their total and bank-specific liabilities by type of financing. As shown by Morais et al. (2019), this sample of firms is representative of the universe of sectors and locations in Mexico, albeit somewhat skewed toward larger firms. We complement this data set with a measure of GDP for Mexico's 32 states, normalized to 2004, which was obtained from the National Statistics Institute. In addition to the total GDP, we also use information on the GDP contributed by the primary sector of each state, consisting of mining and agriculture; the GDP contributed by the secondary sector, covering manufacturing and construction; and the GDP contributed by the tertiary sector, defined as services.

The third data set contains the monthly balance sheet information of the 18 commercial banks in our sample, representing more than 98 percent of commercial bank lending.[6] We merge this data set with information from Bloomberg on the stock prices and CDS spreads of the banks.

Overall, our data contain a total of 1,718,740 loans to firms in the energy and non-energy-related sectors. We classify firms as belonging to an energy-related sector according to their 5-digit North American Industry Classification System (NAICS) codes.[7] The summary statistics for our sample are shown in Table 1, grouped in five panels: (i) bank-month-level indicators, (ii) loan-level variables of firms in energy-related sectors, (iii) loan-level variables of firms in non-energy sectors, (iv) real outcomes at the firm-year level, and (v) GDP measures at the state-quarter level. Table A1 in the appendix presents the definitions of all the variables.

The first variable in Table 1, panel A, captures the banks' exposure to borrowers in energy-related sectors as a share of their tier 1 capital. On average, the ratio of exposure to capital is 9.9 percent, with banks in the bottom decile having no exposure to the energy sector, while banks in the top decile have exposure above 25 percent. Our measure of exposure follows the Basel Committee's assessment of exposure to related entities, which is defined as the credit volume of a bank to related entities as a share of its tier 1 capital.[8]

The next variables in panel A correspond to different elements of the banks' balance sheets, including their tier 1 capital ratios, lending portfolio, and delinquency rates, along with statistics on the banks' stock prices and CDS spreads. The average tier 1 capital ratio of the banks is 15.4 percent, with the banks in the bottom decile having a capital ratio of 12.5 percent, while the banks in the top decile have a capital ratio of 18.5 percent. The banks vary greatly in size, with the average bank lending more than Mex$3,000 million, and the banks in the top decile lending 100 times as much as the banks in the lowest decile. Delinquency rates are low. On average, 2.4 percent of the banks' loans are more than 90 days late, and the banks in the top decile have delinquencies of

[6] To guarantee the comparability of our results across banks, and given our focus on commercial lending, we exclude from our analysis banks that specialize in consumer lending as well as niche banking.
[7] Table A2 in the appendix displays the NAICS energy-related sectors as well as their descriptions.
[8] According to the Basel Committee on Banking Supervision (2014), two entities are *related*: (i) if one of the counterparties, directly or indirectly, has control over the other, or, (ii) if 50 percent or more of one counterparty's receipts comes from transactions with the other counterparty, or (iii) if a significant part of a counterparty's production is sold to another counterparty, or (iv) if financial problems of one counterparty cause difficulties for the other counterparties, or (v) if counterparties rely on the same source for their funding and an alternative provider cannot be found in a timely manner.

around 4.7 percent. Finally, the bottom line of panel A shows the statistics for the banks' ratio of exposure to the energy sector in the month prior to the energy price shock. On average, the exposure is around 8 percent, with banks in the bottom decile having zero exposure to the energy sector, whereas banks in the top decile have 19.6 percent exposure.

Table 1, panel B, reports the loan characteristics of firms operating in energy-related sectors. Although the average bank loan of an energy firm is around Mex$89 million, the median loan size is Mex$1.5 million. Interest rates average 11.4 percent, with loans in the bottom decile having rates as low as 4.4 percent and in the top decile 18 percent. The maturity of loans is on average around two years, with loans in the bottom decile having maturities of around two months, whereas the top decile has maturities of four years.[9] These short maturities are consistent with most loans being destined for working capital. Collateral rates average 14.6 percent of the value of the loan and, again, there is great variation in the amount of collateral required across loans. Although the median loan is uncollateralized, loans in the top decile require collateral of more than half their value. The loan characteristics of firms operating in non-energy sectors display similar patterns as those of firms in the energy sector (Table 1, panel C).

The last two panels in Table 1 present summary statistics for real outcomes at the firm-year level and aggregate production at the state-quarter level. As panel D shows, the median bank debt of firms according to the credit registry is around Mex$730,000. From the Orbis data set, we find that the median liabilities of firms are around Mex$350 million, with median assets and revenues of around Mex$1.1 billion and Mex$800 million, respectively. We construct $AvgExposureEnergy_{m,Aug14}$, a measure of banks' exposure to the energy price shock at the municipality level, as the average exposure to the energy sector in August 2014, weighted by loan value, of the banks serving municipality m.[10] Given that lending tends to be local (Degryse and Ongena 2005), this measure allows us to capture variation in the exposure of firms to banks that were more affected by the shock.

Finally, panel E shows two statistics at the state-quarter level. The first one is the state GDP, which is measured as an index normalized for each state to its level in January 2014. The second variable, $AvgExposureEnergy_{s,Aug14}$, corresponds to the average exposure to the energy

[9] These maturities do not include revolving loans.
[10] In Mexico, there are 2,448 municipalities, with an average population of around 400,000 people.

sector of banks in state *s* in August 2014, the month prior to the oil price shock. Although the average exposure of banks across states is 12.1 percent, for states in the bottom decile it is 9.6 percent, and for states in the top decile it is 14.3 percent.

3. Methodology

We use the 2014 collapse of global energy prices as an exogenous shock to the Mexican banking sector to assess the implications for banks of large exposures to a troubled sector. Banks with large exposures to ailing sectors may suffer due to weaker capital ratios as loans become delinquent, or losses on those exposures as loans default. Therefore, the banks might have incentives to expand lending to these borrowers. However, these actions can come at the expense of increased risk and lower returns, by taking lending away from borrowers in unaffected sectors.

To investigate the impact of this external shock on banks' balance sheets and credit allocation, we adopt a difference-in-differences approach in which treatment is continuous and corresponds to the banks' exposure to borrowers in energy-related sectors in the month prior to the unanticipated shock. This measure of bank exposure consists of the August 2014 ratio of loans to firms in energy-related sectors issued by a bank over its tier 1 capital.[11]

In Figure 2, we classify banks into two groups according to their August 2014 exposure to the energy sector. The three panels in the figure provide descriptive evidence that the effect of the global energy price collapse was more pronounced among banks with greater exposure to the energy sector prior to the price drop. The group labeled "high exposure" includes banks with exposures above the median (5 percent) for the selected date, while "low exposure" banks had exposures below the median. For each group, we plot their exposures to the energy sector (panel A), CDS spreads (panel B), and stock prices (panel C) from January 2013 to June 2016.

Panel A shows that although there were substantial differences in the level of exposure to the energy sector across banks prior to the shock, the variation across these groups was constant from January 2013 through August 2014 and followed a parallel trend. The shares of lending to energy firms of banks above and below the median exposure were on average around 10 and 3.8

[11] However, our results remain unchanged using alternative measures of exposure or different periods (Table A6 in the appendix). These measures correspond to the December 2012—the month prior to the start of our sample—exposure to energy firms of banks and the December 2012 number of branches in energy-intensive municipalities over the total number of branches of a bank.

percent, respectively. However, after the price shock, banks that were more exposed increased their exposure to the sector, reaching 30 percent by mid-2016, while the share of lending to the energy sector by banks that were less exposed was around 8 percent. The data thus suggests that the increased share of bank lending to the energy sector that followed the drop in oil prices (Figure A1) was driven by banks with greater exposures.

Furthermore, panels B and C of Figure 2 show that although both types of banks had similar trends in their CDS spreads and stock prices, these trends diverged after the energy price drop. Normalizing the CDS spreads of both groups of banks to their values in August 2014, we find that through mid-2016, the banks with high exposure saw their CDS spreads reach 100 basis points, whereas the remaining banks reached only 50 basis points. Similarly, the stock prices of banks with high exposure declined by around 12 percent through mid-2016, whereas the stock prices of the banks with low exposure increased 10 percent. All in all, this descriptive evidence suggests that the financial conditions of banks with higher exposure to the energy sector became relatively worse following the collapse of energy prices.

We run equation 1 to test more formally the impact that exposure to the energy sector had on the banks' balance sheets after the collapse of energy prices.

$$y_{b,m} = \alpha + \beta ExposureEnergy_{b,Aug14} * Post_m + \gamma_m + \gamma_b + \varepsilon_{b,m} \quad (1)$$

Our five outcomes of interest ($y_{b,m}$) at the bank-month level correspond to the exposure to the energy sector, total lending, CDS spreads, stock prices, and delinquency ratio. We regress these outcomes on the interaction of the August 2014 exposure to the energy sector of bank *b*—$ExposureEnergy_{b,Aug14}$—and a dummy variable—$Post_m$—that equals one from September 2014 onward. We also include fixed effects at the bank and month levels, with standard errors double clustered at the bank and month levels.

To study the impact of the energy price shock on loans to energy-related firms by banks with varying exposure to the distressed sector, we use our loan-level data and run the regression summarized in equation 2.

$$y_{f,b,m} = \alpha + \beta ExposureEnergy_{b,Aug14} * Post_m + \gamma_{b,f} + \gamma_m + \varepsilon_{f,b,m} \quad (2)$$

where $y_{f,b,m}$ corresponds to the amount loaned to firm *f* by bank *b* in month *m* for all types of loans as well as working capital and investment loans. The interest rate, collateral rate, and maturity of loans to firm *f* by bank *b* in month *m* are additional credit outcomes that we analyze. Equation 2 includes firm-bank fixed effects, $\gamma_{b,f}$, and month fixed effects, γ_m, with robust standard errors double clustered at the bank and month levels. Furthermore, in some specifications, we include firm-month fixed effects, $\gamma_{f,m}$, to control for changes in the demand for credit.

A key identifying assumption for estimating the causal effects of the change in energy prices is that the trends in the outcomes of interest would have been the same across banks in the absence of the energy price drop. Although this assumption cannot be tested, we test for differences in bank outcomes and their trends before the energy price drop, using the regression outlined in equation 3, constraining the sample to the period before August 2014.

$$y_{b,m} = \alpha + \beta_1 ExposureEnergy_{b,Aug14} + \beta_2 ExposureEnergy_{b,Aug14} * Trend_m + \gamma_m + \varepsilon_{b,m} \quad (3)$$

In equation 3, $y_{b,m}$ corresponds to the outcomes of interest for bank *b* at time *t*, and the term $Trend_m$ consists of a linear trend over time. As before, $ExposureEnergy_{b,Aug14}$ captures bank *b*'s August 2014 exposure to the energy sector. Coefficient β_1 measures whether the average outcomes of banks are statistically different as their exposure to the energy sector varies, whereas coefficient β_2 measures differences in the trends of outcome *y* across banks with varying exposures to the energy sector. Fixed effects at the month level, γ_m, are included in the regression. The results, summarized in Table A3 in the appendix, give credibility to the identification strategy, as they show that there are no statistically significant differences in the pre-shock averages and trends of the outcomes of interest. We conduct an additional pre-trends test using the loan-level data for energy sector borrowers prior to August 2014. The results, displayed in Table A4, also corroborate that there are no statistically significant differences in the loan terms and trends of banks with varying degrees of exposure to the energy sector in the months prior to the shock.

Finally, we test for the existence of nonlinear pre-trends across banks with different exposures to the energy sector prior to the shock. The specification, presented in equation 4, restricts the loan-level data to loans from firms in the energy sector.

$$y_{f,b,q} = \alpha + \sum \beta_m Month_m * ExposureEnergy_{b,Aug14} + \gamma_{f,b} + \gamma_m + \varepsilon_{f,b,q} \quad (4)$$

The dependent variable consists of the value loaned to firm *f* by bank *b* in month *m*. The covariates of interest are monthly dummies interacted with the bank's exposure to the energy sector in August 2014. The β_m coefficients thus measure the monthly variation in the value of credit to energy firms across banks with varying exposures in August of 2014. We include fixed effects at the firm-bank and quarter levels. The β_m coefficients, plotted in Figure 3, give further credibility to our identification strategy. Prior to the energy price drop, banks with varying exposures to the energy sector had the same dynamics on the value of loans to energy firms. However, once the energy prices dropped, the amount of credit to energy firms began increasing significantly as the banks' exposure to the energy sector rose.

4. Results

We start this section by assessing the impact that the collapse of global energy prices had on the balance sheets of banks with varying degrees of exposure to the energy sector around the time of the shock. We then present our loan-level results, which separately analyze the bank lending dynamics of firms in energy-related and all other sectors after the shock. Finally, we summarize the real effects that increased bank exposure to the energy sector had on the economy as a result of the price shock.

4.1. Impact of the Energy Price Shock on Banks' Balance Sheets and Financials

Table 2 summarizes the results of equation 1 for five bank-month variables: exposure to the energy sector (percent), total lending (in logs), CDS spreads (in logs), stock price (in logs), delinquency rates (percent).

We find that the sharp drop in energy prices had a substantially greater effect on banks with higher ex-ante exposure to the energy sector. Compared with banks with less exposure, banks with higher ex-ante exposure to the energy sector increased their lending to the affected sector relatively more after the global price of energy plummeted (column 1). An increase of one standard deviation in exposure to the energy sector in August 2014 leads to an increase of around 1.2 percentage points in the following quarters. As column 2 shows, this increase in lending to the energy sector did not come from an increase in the overall lending of more exposed banks, which suggests that banks reallocated their lending away from other sectors and to energy firms. Columns 3 and 4 indicate that the drop in energy prices increased the risk of banks while reducing their stock prices. An increase of one standard deviation in exposure to the energy sector increases CDS spreads by 10.4 percent (column 3) and reduces stock prices by 3.2 percent (column 4) after the shock. One reason why banks with higher exposure to the energy sector were more affected by the shock is that their borrowers were in distress. The results in column 5 confirm this, as the delinquency rate after the shock increased substantially, given the ex-ante bank exposure. An increase of one standard deviation in exposure to the energy sector leads to an increase in delinquencies in the portfolios of banks by about 0.16 percentage point (roughly 8 percent).

4.2. Impact on Credit to Energy Borrowers

The results suggest that banks with higher ex-ante exposure to the energy sector expanded their lending to the energy sector after the collapse of energy prices. In this section, we use loan-level data on the universe of loans to energy sector borrowers to document how the credit terms of firms in the energy sector changed in response to the energy price shock.

Table 3, panel A, summarizes the results of our benchmark equation 2 on three credit outcomes: (i) total lending, (ii) lending for working capital, and (iii) lending for investment projects. All the regressions include *Bank*Firm* and *Month* fixed effects, and the regressions displayed in columns 2, 4, and 6 further include fixed effects at the *Firm*Month* level. The inclusion of the latter limits our sample to firms that borrowed from more than one bank at a given point in time. However, this helps us isolate time-varying changes in the demand for credit of borrowers in the energy sector. This is important, as the decline in energy prices directly impacted producers' revenues, forcing them to demand more external funds.

Columns 1 and 2 corroborate the earlier finding that banks with higher ex-ante exposure to the energy sector channeled more credit to the sector. Once we control for time-varying changes in the demand for credit, we find that banks that were more exposed ex-ante injected more credit in energy borrowers. An increase of one standard deviation in ex-ante exposure to the energy sector leads to an increase in the value of loans to firms in the energy sector of around 18 percent. Columns 3 to 6 show that the increase in credit was mainly for working capital, reflecting that distressed energy firms financed their working capital needs rather than starting new investment projects. An increase of one standard deviation in ex-ante exposure to the energy sector leads to an increase in lending for working capital of almost 85 percent, but it has no impact on lending for investment.

Our evidence suggests that, compared with less exposed banks, banks that were more exposed to the energy sector had a greater increase in lending to energy firms. To understand whether the increased lending was driven by the supply of credit, rather than expansion in the demand for credit, we analyze the credit terms offered. The results on the interest rates, collateral, and maturity of the loans obtained by energy sector borrowers are displayed in Table 3, panel B. Columns 1 and 2 suggest that, compared with less exposed banks, banks with higher ex-ante exposure to the energy sector relaxed the interest rates on loans to the affected firms significantly more. For example, an increase of one standard deviation in ex-ante exposure leads to a 0.7 percentage point decrease in lending rates (roughly 7.5 percent). Furthermore, as columns 3 to 6 indicate, we find no evidence that the collateral requirements or maturity of the loans to energy firms changed differentially as ex-ante bank exposure to the sector varied. These results suggest that the increase in lending to firms in the energy sector by highly exposed banks was driven in large part by an expansion in supply.

Finally, we explore the existence of heterogeneity across borrowers in the energy sector with different outstanding loan amounts. We test whether the banks' response depended on their relative bargaining power over individual borrowers (Rajan 1992; Santos and Winton 2019). Figure A2 in the appendix presents a simple bin scatter plot (to preserve the anonymity of the borrowers) with censored tails. The results suggest that the increase in credit supply in the energy sector was mainly targeted toward borrowers with larger outstanding loan amounts. Table A5 in the appendix presents the results of a series of regressions where we run equation 2 for two samples of borrowers, depending on whether their outstanding loan amounts in August of 2014 were below (Small) or above (Large) the median. The results suggest that banks expanded their credit to borrowers with ex-ante larger credit amounts relatively more, especially credit for working capital. This finding is consistent with borrowers holding up their lenders, given the borrowers' higher bargaining position.

4.3. Spillovers to Non-Energy Borrowers

Our earlier results at the bank-month level show that although banks with higher ex-ante exposure increased their lending to the energy sector, they did so without increasing their total lending. Therefore, the increase in credit toward energy firms should have affected the access to credit of firms in other sectors. In this section, we restrict the sample to borrowers in non-energy-related sectors, to analyze how and which non-energy borrowers were affected by this reallocation.

Table 4, panel A, presents the results of equation 2 for the sample of borrowers in non-energy sectors. The three credit outcomes displayed are the log of total bank lending as well as the log of bank lending for working capital and investment projects. We include *Bank*Firm* and *Month* fixed effects in all the regressions, and *Firm*Month* fixed effects in the regressions displayed in columns 2, 4, and 6, to fully control for time-varying changes in the demand for credit. In the table, the first two columns show that, as a result of the collapse of oil prices, banks that were more exposed to the energy sector had a greater reduction in the amount of credit to firms in sectors that were not directly affected by the shock. An increase of one standard deviation in a bank's ex-ante exposure to the energy sector leads to a reduction in the loan volume to firms in other sectors of around 13 percent. We decompose this result to understand which type of loans—for working capital or investment—contracted the most. The results are displayed in columns 3 to 6. Although loans for working capital contracted on average by 8.5 percent, loans for the investment sector contracted by a full 30 percent. These results suggest that most of the contraction of bank credit was driven by a reduction in loans for investment, which are typically associated with increases in firm productivity.

Overall, our evidence suggests that banks with greater ex-ante exposure to the energy sector had greater contractions in their credit to non–energy sector borrowers. This contraction in credit was concentrated in financing for investment projects. Next, we investigate whether there was heterogeneity in the contraction of lending across borrowers. We check whether the impact was higher among smaller firms, which tend to be considered riskier (Morais et al. 2019). We divide non-energy borrowers into two groups, those with more or fewer than 50 employees in 2014 (following Beck and Demirguc-Kunt (2006)), and run equation 2 on each sample. The results, which are summarized in Table 4, panel B, suggest that the contraction of credit almost exclusively affected smaller firms in non-energy sectors. For this subsample of borrowers, an increase of one standard deviation in ex-ante bank exposure to the energy sector leads to a contraction in the volume of lending of around 16.4 percent, whereas for larger firms the impact on total lending volume is statistically indistinguishable from 0.

4.4. Real Effects

The results suggest that the energy price collapse impacted the credit allocation of banks that were more exposed to energy-related sectors. Banks that were more exposed increased lending to firms in the affected sectors and contracted credit to firms in other sectors. If borrowers were not able to switch credit suppliers, the contraction in bank lending might have had a material impact on their real outcomes.

Using firm-year-level data for the sample of firms in non-energy sectors, we run the following specification:

$$y_{f,y} = \alpha + \beta AvgExposureEnergy_{m,Aug14} * Post_y + \gamma_f + \gamma_y + \varepsilon_{f,y} \quad (5)$$

where the real outcome $y_{f,y}$ of firm f in year y corresponds to one of the following variables: total lending, loans for working capital, loans for investment projects, total liabilities, assets, and revenue.[12] $AvgExposureEnergy_{m,Aug14}$ is a measure of exposure to the energy sector in August 2014 of a firm headquartered in municipality m. $Post_y$ is an indicator that the yearly observation is after 2014. β is the coefficient of interest, as it measures the extent to which the real outcomes of firms in municipalities with more banks with greater ex-ante exposure were affected by the drop in energy prices. Finally, γ_f and γ_y are fixed effects at the firm and year levels, respectively, and $\varepsilon_{f,y}$ is the error term clustered at the municipality level.

The results of this exercise are displayed in Table 5. Starting with information from the credit registry of bank loans, we find that an increase of one standard deviation in the exposure of banks with which a firm has relations reduces total lending by 2.1 percent. Again, the impact is much larger for financing for investment projects. Total loans for working capital contract by 1.9 percent, and loans for investment contract by 12.4 percent. These results suggest that non-energy firms are unable to smooth the shock that their banks receive. We also find evidence that other firm outcomes (liabilities, assets, and sales) were negatively impacted by the municipality's exposure to the energy sector. An increase of one standard deviation in a municipality's exposure to the energy sector reduces total firm liabilities by around 2.9 percent and total firm assets by

[12] Orbis information tends to refer to the month of December. For the credit registry outcomes (total loans, loans for working capital, and loans for investment) for each firm-year pair, we selected the December value.

around 2.6 percent. However, we do not find any impact on total sales. Overall, we uncover evidence suggesting that non-energy firms experienced a larger contraction in their liabilities (particularly investment) and assets if they were headquartered in municipalities with high exposure to banks that were more impacted by the decline in energy prices.

In addition to these firm-level results, we analyze the impact of the collapse of energy prices at the more aggregated state level. We run a similar specification using state-quarter-level data. In this exercise, we relate quarterly state GDP to the average ex-ante exposure to the energy sector of banks operating in a state. We use the following specification:

$$y_{s,q} = \alpha + \beta AvgExposureEnergy_{s,Aug14} * Post_q + \gamma_s + \gamma_q + \varepsilon_{f,y} \tag{6}$$

where $y_{s,q}$ is the total GDP of state s in quarter q. Furthermore, we study the decomposition of the GDP in the three sectors: primary, secondary, and tertiary. The regressor—$AvgExposureEnergy_{s,Aug14}$—is the average ex-ante exposure to the energy sector of banks operating in state s, weighted by loan value. Finally, we include state γ_s and quarter γ_q fixed effects to control for state-specific, time-unvarying variation as well as aggregate time variation affecting all states, and errors are clustered at the state level. Our coefficient of interest is β, which indicates whether the aggregate production of a given state was differentially affected by the drop in energy prices as the average ex-ante exposure of its banks to the energy sector increased. To isolate the impact of the contraction in bank lending from the drop in energy prices, we present the results for all 32 states in Mexico and the 30 states in Mexico that do not produce energy.[13]

Table 6 presents the findings. Focusing on the non-energy-producing states, an increase of one standard deviation in the exposure of a state to the energy sector reduces the state's GDP by 1.8 percentage points. We interpret this finding as evidence that the reduction in output was caused by the contraction in lending of banks that were highly exposed ex-ante. Furthermore, as the results in the table show, the brunt of the impact was on the GDP of the secondary sector. Relative to the tertiary sector, the secondary sector tends to be more capital intensive and dependent on external financing (Buera, Kaboski, and Shin 2011). An increase of one standard deviation in a state's ex-

[13] Tabasco and Veracruz are the main oil producing states in Mexico. In these states, oil extraction and production represent roughly 40 percent of state-level GDP. For the remaining five producers—Chiapas, Tamaulipas, Puebla, San Luis Potosi, and Hidalgo—energy production is residual and represents less than 2 percent of state GDP.

ante exposure to the energy sector reduces the state's GDP from the secondary sector by around 3.9 percent, whereas the GDP from the tertiary sector is not impacted in a statistically significant way.

5. Conclusions

We analyzed the credit supply of banks in the event of large exposures to financially stressed borrowers. We studied the impact of the halving of energy prices in late 2014 on the banking sector in Mexico, a large energy producer. As energy prices declined, the CDS spreads of energy producers ramped up, as their working capital and financial needs outpaced their expected revenues. Using the universe of corporate loans to energy and non-energy firms, we found that banks that were more exposed to the energy sector prior to the shock notably increased their exposure to the sector ex post—by offering loans of higher volume and reducing interest rates on those loans. This behavior suggests an attempt on behalf of largely exposed banks to avoid realizing losses on an important part of their loan portfolios, even at the cost of jeopardizing their regulatory liquidity and capitalization ratios. Controlling for demand shocks, we found that banks that were more exposed to the energy sector contracted their credit to firms in non-energy sectors, with important negative real effects.

The relation between large and concentrated credit exposures of banks and commodity prices has not been closely studied in the literature. Our findings are particularly relevant for commodity-producing economies that are exposed to global fluctuations in commodity prices. The channel that we identify outlines the need to account for proper risk management of banks with large concentrations in their credit portfolios that are subject to price volatility.

References

Acharya, V.V., I. Hasan, and A. Saunders. 2006. "Should Banks Be Diversified? Evidence from Individual Bank Loan Portfolios." *Journal of Business* 79 (3): 1355–1412.

Acharya, V. V., and S. Steffen. 2015. "The Greatest Carry Trade Ever? Understanding Eurozone Bank Risks." *Journal of Financial Economics* 115: 215–36.

Agarwal, I., R. Duttagupta, and A. F. Presbitero. 2019. "Commodity Prices and Bank Lending." *Economic Inquiry* 58 (2): 953–79.

Alesina, A., F. R. Campante, and G. Tabellini. 2008. "Why Is Fiscal Policy Often Procyclical?" *Journal of the European Economic Association* 6 (5): 1006–36.

Armstrong, R, S. Morris, R. Smith. 2020. "Bank Investors Confront a New Fear: Oil Company Defaults" *Financial Times,* March 9, 2020

Basel Committee on Banking Supervision. 2014. "Supervisory Framework for Measuring and Controlling Large Exposures." Basel Committee on Banking Supervision, Basel, Switzerland.

Beck, T., O. De Jonghe, and K. Mulier. 2017. "Bank Sectoral Concentration and (Systemic) Risk: Evidence from a Worldwide Sample of Banks." CEPR Discussion Paper 12009, Center for Economic and Policy Research, Washington, DC.

Beck, T., and A. Demirguc-Kunt. 2006. "Small and Medium-Size Enterprises: Access to Finance as a Growth Constraint." *Journal of Banking & Finance* 30: 2931–43.

Berger, A. N., I. Hasan, and M. Zhou. 2010. "The Effects of Focus versus Diversification on Bank Performance: Evidence from Chinese Banks." *Journal of Banking & Finance* 34 (7): 1417–35.

Bidder, R. M., J. R. Krainer, and A. H. Shapiro. 2017. "De-Leveraging or De-Risking? How Banks Cope with Loss." Working Paper 2017-03, Federal Reserve Board of San Francisco.

Blanchard, O., and J. Gali. 2010. "Labor Markets and Monetary Policy: A New Keynesian Model with Unemployment." *American Economic Journal: Macroeconomics* 2 (2): 1–30.

Boyd, J. H., and E. C. Prescott. 1986. "Financial Intermediary-Coalitions." *Journal of Economic Theory* 38 (2): 211–32.

Bruckner, M., and A. Ciccone. 2010. "International Commodity Prices, Growth and the Outbreak of Civil War in Sub-Saharan Africa." *Economic Journal* 120 (544): 519–34.

Brunnermeier, M. K. 2009. "Deciphering the Liquidity and Credit Crunch 2007-2008." *Journal of Economic Perspectives* 23 (1): 77–100.

Buera, F., J. Kaboski, and Y. Shin. 2011. "Finance and Development: A Tale of Two Sectors." *American Economic Review* 101 (5): 1964–2002.

Caballero, R. J., T. Hoshi, and A. K. Kashyap. 2008. "Zombie Lending and Depressed Restructuring in Japan." *American Economic Review* 98 (5): 1943–77.

De Jonghe, O., H. Dewachter, K. Mulier, S. Ongena, and G. Schepens. 2019. "Some Borrowers Are More Equal Than Others: Bank Funding Shocks and Credit Reallocation." *Review of Finance* 24 (1): 1–43.

Deaton, A. 1999. "Commodity Prices and Growth in Africa." *Journal of Economic Perspectives* 13 (3): 23–40.

Deaton, A., and R. Miller. 1996. "International Commodity Prices, Macroeconomic Performance, and Politics in Sub-Saharan Africa." *Journal of African Economies* 5 (3): 99–191.

Degryse, H., and S. Ongena. 2005. "Distance, Lending Relationships, and Competition." *The Journal of Finance* 60 (1): 231-266.

Dehn, J. 2000. "Commodity Price Uncertainty and Shocks: Implications for Economic Growth." CSAE Working Paper Series 2000-10, Center for the Study of African Economies, University of Oxford.

Diamond, D. W. 1984. "Financial Intermediation and Delegated Monitoring." *Review of Economic Studies* 51 (3): 393–414.

FSI (Financial Stability Institute). 2019. "Pillar 3 Framework – Executive Summary." FSI, Basel, Switzerland, BIS.org.

Gilje, E. P., E. Loutskina, and P. E. Strahan. 2016. "Exporting Liquidity: Branch Banking and Financial Integration." *Journal of Finance* 71(3): 1159–84.

Goetz, M. R., L. Laeven, and R. Levine. 2016. "Does the Geographic Expansion of Banks Reduce Risk?" *Journal of Financial Economics* 120 (2): 346–62.

Ippolito, F., J.-L. Peydro, A. Polo, and E. Sette. 2016. "Double Bank Runs and Liquidity Risk Management." *Journal of Financial Economics* 122 (1): 135–54.

Iyer, R., and J.-L. Peydro. 2011. "Interbank Contagion at Work: Evidence from a Natural Experiment." *Review of Financial Studies* 24 (4): 1337–77.

Kashyap, A. K., and J. C. Stein. 2000. "What Do a Million Observations on Banks Say about the Transmission of Monetary Policy?" *American Economic Review* 90 (3): 407–28.

Khwaja, A. I., and A. Mian. 2008. "Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market." *American Economic Review* 98 (4): 1413–42.

Kinda, T., M. Mlachila, and R. Ouedraogo. 2016. "Commodity Price Shocks and Financial Sector Fragility." IMF WP/16/12, International Monetary Fund, Washington, DC.

La Porta, R., Lopez-de-Silanes, F. and G. Zamarripa. 2003. "Related Lending." *Quarterly Journal of Economics* 118 (1): 231-268.

Laeven, L., and R. Levine. 2007. "Is There a Diversification Discount in Financial Conglomerates?" *Journal of Financial Economics* 85 (2): 331–67.

Morais, B., J.-L. Peydro, J. Roldan, and C. Ruiz. 2019. "The International Bank Lending Channel of Monetary Policy Rates and QE: Credit Supply, Reach-for-Yield, and Real Effects." *Journal of Finance* 74 (1): 55–90.

Paravisini, D., P. Schnabl, and V. Rappoport. 2017. "Specialization in Bank Lending: Evidence from Exporting Firms." CEPR Discussion Papers 12156, Center for Economic and Policy Research, Washington, DC.

Peek, J., and E. S. Rosengren. 2005. "Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan." *American Economic Review* 95 (4): 1144–66.

Rajan, R, G. 1992. "Insiders and Outsiders: The Choice between Informed and Arm's-Length Debt." *Journal of Finance* 47 (4): 1367–1400.

Santos, J. A. C., and A. Winton. 2019. "Bank Capital, Borrower Power, and Loan Rates." *Review of Financial Studies* 32 (11): 4501–41.

Schnabl, P. 2012. "The International Transmission of Bank Liquidity Shocks: Evidence from an Emerging Market." *Journal of Finance* 67 (3): 897–932.

Tabak, B. M., D. M. Fazio, and D. O. Cajueiro. 2011. "The Effects of Loan Portfolio Concentration on Brazilian Banks' Return and Risk." *Journal of Banking & Finance* 35 (11): 3065–76.

Westernhagen, N., E. Harada, T. Nagata, B. Vale, J. Ayuso, J. Saurina, S. Daltung, S. Ziegler, E. Kent, J. Reidhill, and S. Peristiani. 2004. "Bank Failures in Mature Economies." Working Paper 13, Basel Committee on Banking Supervision, Basel, Switzerland.

Winton, A. 1999. "Don't Put All Your Eggs in One Basket? Diversification and Specialization in Lending." Working Paper 16, Wharton School Center for Financial Institutions, University of Pennsylvania, Philadelphia, PA.

World Bank. 2018. *Global Economic Prospects*. World Bank, Washington, DC, WorldBank.org.

Figure 1 – Oil Prices and CDS Spreads of Energy Producers

This figure displays the movements in oil prices—West Texas Intermediate—in dollars as well as the movements in the CDS spreads of energy firms in Mexico and in other emerging economies. The sample period spans from January 2013 to June 2016.

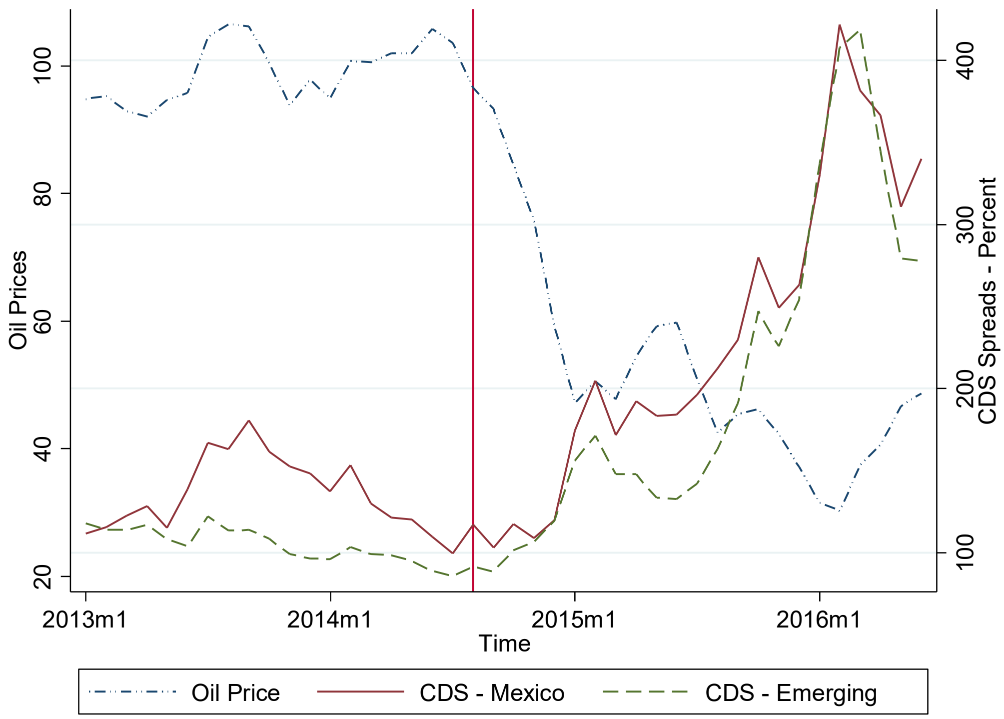

Figure 2 – Bank Exposure to the Energy Sector and Financial Variables

This figure displays the evolution of exposure to the energy sector of Mexican banks as well as their stock prices and CDS spreads. We split the sample into two groups with below and above median exposure to the energy sector, defined as the value of total loans outstanding to the energy sector over total capital in August 2014. The series of CDS spreads of five-year bonds and stock prices are normalized to August 2014. The sample period is from January 2013 to June 2016.

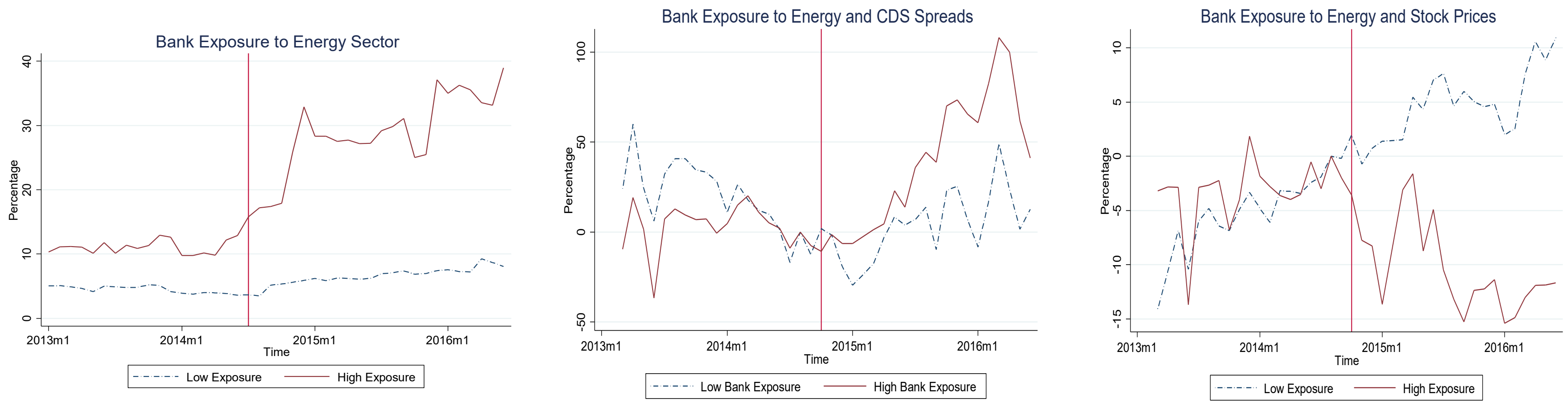

Figure 3 – Evolution of Bank Exposure to the Energy Sector

This figure displays quarterly coefficients of a bank-month regression where the dependent variable is the share of loans to the energy sector by bank b in month m. The coefficients displayed are the interaction of the bank's ex-ante exposure to the energy sector, defined as the value of total loans outstanding to the energy sector over total capital in August 2014, and month dummies. The coefficients represent the relative changes in banks' exposure to the energy sector, given their exposure in August 2014. The regression includes bank and month fixed effects. Standard errors are double clustered at the bank and month levels. Vertical bars represent the confidence intervals of the coefficients at 90 percent. The sample period is from January 2013 to June 2016.

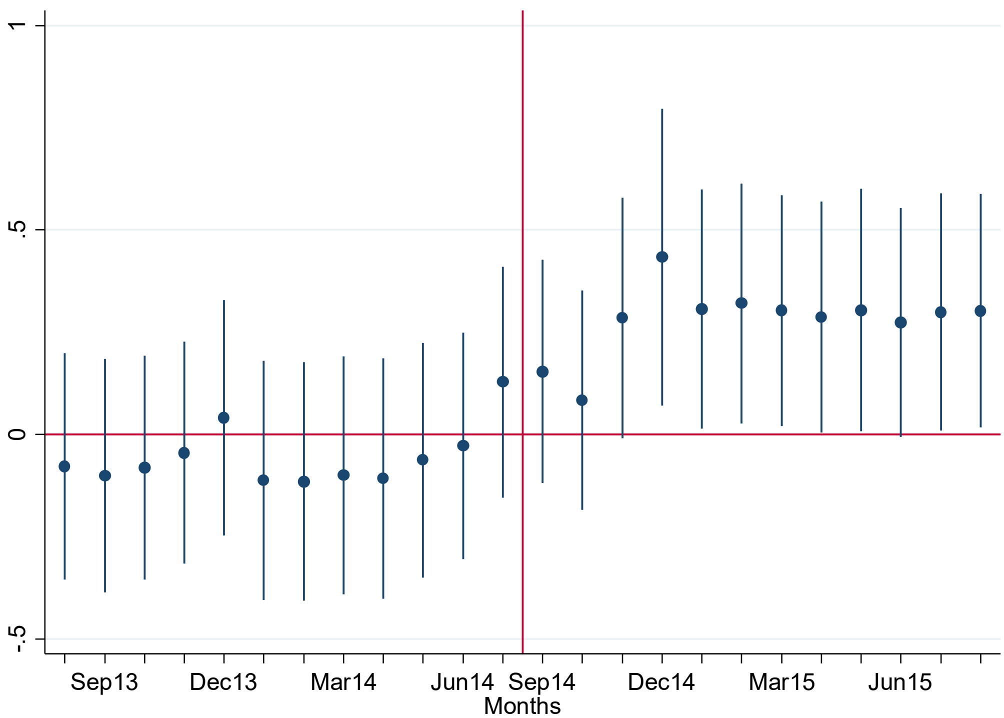

Table 1. Summary Statistics

This table reports the summary statistics of our sample for January 2013 to June 2016. All variable definitions are provided in Table A1.

	# Obs	Average	p10	Median	p90	Std dev
Panel A. Bank-month-level variables						
$ExposureEnergy_{b,m}$ (%)	897	9.9	0	5.9	25.4	12.1
Tier 1 Capital $Ratio_{b,m}$ (%)	897	15.4	12.5	15.3	18.5	2.2
Total $Lending_{b,m}$ (logs)	897	21.8	19.6	21.3	24.2	1.8
$Delinquency_{b,m}$ (%)	897	2.4	0.4	2	4.7	2
$CDS_{b,m}$ (basis points)	367	410	321	425	492	71
Stock $Price_{b,m}$ (index)	470	3.4	0.7	3.9	5.2	1.6
$ExposureEnergy_{b,Aug14}$ (%)	897	8.0	0	5.0	19.6	6.5
Panel B. Loan-level variables of firms in energy-related sectors						
Total $Lending_{f,b,m}$ ('000)	34,741	89,790	96	1,560	126,930	307,605
Loans to working $capital_{f,b,m}$ ('000)	34,741	78,848	25	1,218	96,521	285,116
Loans to $investment_{,b,m}$ ('000)	34,741	2,980	0	0	131	13,470
Interest $Rate_{f,b,m}$ (%)	31,257	11.4	4.4	11.8	18.0	10.7
$Maturity_{f,b,m}$ (months)	31,257	25	2.4	20.4	52.0	25.7
$Collateral_{f,b,m}$ (%)	31,257	14.6	0.0	0.0	54.7	29.1
Panel C. Loan-level variables of firms in non-energy sectors						
Total $Lending_{f,b,m}$ ('000)	1,684,329	6,225	48	511	5,179	58,224
- Working $capital_{f,b,m}$ ('000)	1,600,896	5,509	46	500	4,511	54,745
- $Investment_{f,b,m}$ ('000)	145,324	11,782	53	1,159	20,000	71,286
Interest $Rate_{f,b,m}$ (%)	1,684,329	13.4	7.8	13.0	19.0	4.2
$Maturity_{f,b,m}$ (years)	1,668,951	33	3.0	19.3	43.1	111.8
$Collateral_{f,b,m}$ (%)	1,684,329	13.2	0.0	0.0	50.0	27.2
Panel D. Firm-year-level variables						
Total $Lending_{f,y}$ ('000)	66,592	10,337	69	732	7,962	117,140
- Working $Capital_{f,y}$ ('000)	64,561	8,902	67	696	6,894	105,158
- $Investment_{f,y}$ ('000)	7,009	15,757	57	1,511	26,872	93,249
$AvgExposureEnergy_{f,Aug14}$ (%)	66,592	13.4	3.2	14.5	19.6	4.8
$Liabilities_{f,y}$ (millions)	2,132	6,466	42	344	20,947	15,655
$Assets_{f,y}$ (millions)	2,350	19,607	101	1,146	50,739	47,695
$Revenues_{f,y}$ (millions)	2,350	7,056	179	818	23,431	15,245
$AvgExposureEnergy_{m,Aug14}$ (%)	2,350	9.8	7.7	10.3	11.5	2.1
Panel E. State-quarter-level variables						
Total $GDP_{s,q}$ (index)	512	4.6	4.6	4.6	4.7	0.1
$AvgExposureEnergy_{s,Aug14}$ (%)	512	12.1	9.6	12.1	14.3	1.6

Table 2. Evolution of Bank-Level Indicators after the Shock

Regressions at the bank*month level using bank balance sheet data. Dependent variables are listed in the columns. $ExposureEnergy_{b,m}$ represents lending to the energy sector as a share of its tier 1 capital of bank *b* in month *m*. $Total\ Lending_{b,m}$ are total monthly loans of bank *b* in logs. $CDS\ Spreads_{b,m}$ is the log of CDS spreads of five-year maturity bonds of bank *b* in month *m*. $Stock\ Price_{b,m}$ is the log of the stock price of bank *b* in month *m*. $Delinquency_{b,m}$ is the share of delinquent loans of bank *b* in month *m*. The regressor $ExposureEnergy_{b,Aug14}$ represents the exposure to the energy sector of bank *b* in August 2014. $Post_m$ is an indicator for month *m* after the energy price shock in August 2014. All regressions include bank and month fixed effects. The results show that there was relocation of lending toward the energy sector by banks that were more exposed to it. However, other margins were unchanged, suggesting that there was a reallocation across sectors. Robust standard errors are double clustered at the bank and month levels. Detailed variable definitions are provided in Table A1. Observations are at the bank-month level for January 2013 to June 2016. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

	$ExposureEnergy_{b,m}$	$Total\ Lending_{b,m}$	$CDS\ Spreads_{b,m}$	$Stock\ Price_{b,m}$	$Delinquency_{b,m}$
	(1)	(2)	(3)	(4)	(5)
$ExposureEnergy_{b,Aug14}*Post_m$	0.192***	-0.003	0.016*	-0.005***	0.024***
	(0.022)	(0.002)	(0.009)	(0.002)	(0.007)
Observations	612	612	272	350	612
R-squared	0.884	0.992	0.706	0.996	0.896
Bank FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
$SD(ExposureEnergy_{b,Aug14})$	6.5	6.5	6.3	6.2	6.5

Table 3. Panel A - Lending Volumes to the Energy Sector

This panel displays the impact of bank exposure to the energy sector and lending to borrowers in the energy sector. The dependent variables are in logs. *Total Lending*$_{f,b,m}$ is the total lending value to firm *f* by bank *b* in month *m*. *Working Capital*$_{f,b,m}$ and *Investment*$_{f,b,m}$ are total lending value destined to working capital and investment, respectively. *ExposureEnergy*$_{b,Aug14}$ represents lending to the energy sector as a share of its tier 1 capital of bank *b* in August 2014. *Post*$_m$ is an indicator that the month *m* is after the energy price shock in August 2014. Robust standard errors are double clustered at the bank and month levels. Detailed variable definitions are provided in Table A1. Observations are at the firm-bank-month level for January 2013 to June 2016. *** p<0.01, ** p<0.05, * p<0.1.

	Total Lending$_{f,b,m}$		Working Capital$_{f,b,m}$		Investment$_{f,b,m}$	
	(1)	(2)	(3)	(4)	(5)	(6)
ExposureEnergy$_{b,Aug14}$*Post$_m$	0.03**	0.09***	0.14***	0.32***	-0.05	-0.05
	(0.01)	(0.02)	(0.05)	(0.09)	(0.04)	(0.04)
Observations	34,998	16,898	34,998	16,898	34,998	16,898
R-squared	0.88	0.94	0.87	0.92	0.87	0.92
Bank-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	-	Yes	-	Yes	-
Firm-month FE	No	Yes	No	Yes	No	Yes
SD(ExposureEnergy$_{b,Aug14}$)	6.1	6.1	6.1	6.1	6.1	6.1

Table 3. Panel B - Terms on Loans to the Energy Sector

This panel displays the impact of bank exposure to the energy sector and its lending to energy borrowers. The dependent variables are $Interest\ Rate_{f,b,m}$, which is the total interest rate charged to firm *f* by bank *b in* month *m*; $Collateral_{f,b,m}$, which is the fraction of loans that is guaranteed; and $Maturity_{f,b,m}$, which is the average length in log months of loan duration. $ExposureEnergy_{b,Aug14}$ represents lending to the energy sector as a share of its tier 1 capital of bank *b* in August 2014. $Post_m$ is an indicator that the month *m* is after the energy price shock in August 2014. Standard errors double clustered at the bank and month levels. Detailed variable definitions are provided in Table A1. Observations are at the firm-bank-month level for January 2013 to June 2016. *** p<0.01, ** p<0.05, * p<0.1.

	$Interest\ Rate_{f,b,m}$		$Collateral_{f,b,m}$		$Maturity_{f,b,m}$	
	(1)	(2)	(3)	(4)	(5)	(6)
$ExposureEnergy_{b,Aug14}*Post_m$	-0.13**	-0.11***	0.38	0.51	-0.01	0.03
	(0.05)	(0.04)	(0.77)	(0.55)	(0.02)	(0.02)
Observations	32,358	16,698	32,358	16,698	32,358	16,698
R-squared	0.29	0.75	0.81	0.89	0.67	0.83
Bank-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	-	Yes	-	Yes	-
Firm-month FE	No	Yes	No	Yes	No	Yes
SD($ExposureEnergy_{b,Aug14}$)	6.1	6.1	6.1	6.1	6.1	6.1

Table 4. Panel A - Lending Volumes to Borrowers in Non-Energy Sectors

This panel presents the coefficients of the regression in equation 2, testing the impact of the price shock on loan value to non-energy borrowers. The dependent variables are in logs. $Total\ Lending_{f,b,m}$ is the total lending value to firm f by bank b in month m. $Working\ Capital_{f,b,m}$ and $Investment_{f,b,m}$ are total lending value destined to working capital and investment, respectively. $ExposureEnergy_{b,Aug14}$ represents lending to the energy sector as a share of its tier 1 capital of bank b in August 2014. $Post_m$ is an indicator that the month m is after the energy price shock in August 2014. The results indicate that banks that were more exposed to the energy sector reduced relatively more their lending. Standard errors are double clustered at the bank and month levels. Detailed variable definitions are provided in Table A1. The sample period is from January 2013 to June 2016. *** p<0.01, ** p<0.05, * p<0.1.

	$Total\ Lending_{f,b,m}$		$Working\ Capital_{f,b,m}$		$Investment_{f,b,m}$	
	(1)	(2)	(3)	(4)	(5)	(6)
$ExposureEnergy_{b,Aug14}*Post_m$	-0.022***	-0.017***	-0.014*	0.001	-0.050***	-0.067***
	(0.007)	(0.005)	(0.008)	(0.007)	(0.007)	(0.011)
Observations	1,262,712	573,544	1,262,712	573,544	1,262,712	573,544
R-squared	0.794	0.897	0.824	0.899	0.873	0.921
Bank*firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	-	Yes	-	Yes	-
Firm-month FE	No	Yes	No	Yes	No	Yes
$SD(ExposureEnergy_{b,Aug14})$	6.1	6.1	6.1	6.1	6.1	6.1

Table 4. Panel B - Lending to Non-Energy Sectors, by Borrower Size

This panel presents the coefficients of the regression in equation 2, testing the impact of the price shock on loan value to non-energy borrowers. The dependent variables, all in logs, are loan value, value to working capital, and value to investment to firm *f* in month *m* by bank *b*. $Post_m$ is an indicator that month *m* is after the energy price shock in September 2014. The results indicate that banks that were more exposed to the energy sector reduced relatively more their lending. Standard errors are double clustered at the bank and month levels. Detailed variable definitions are provided in Table A1. The sample period is from January 2013 to June 2016. *** p<0.01, ** p<0.05, * p<0.1.

	$\text{Total Lending}_{f,b,m}$		$\text{Working Capital}_{f,b,m}$		$\text{Investment}_{f,b,m}$	
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{ExposureEnergy}_{b,Aug14} * \text{Post}_m$	-0.027***	-0.005	-0.020**	0.006	-0.047***	-0.062***
	(0.007)	(0.005)	(0.008)	(0.010)	(0.006)	(0.014)
Observations	1,026,135	236,519	1,026,135	236,519	1,026,135	236,519
R-squared	0.766	0.847	0.816	0.840	0.872	0.871
Borrower size	Small	Large	Small	Large	Small	Large
Bank*firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
$\text{SD}(\text{ExposureEnergy}_{b,Aug14})$	6.1	6.1	6.1	6.1	6.1	6.1

Table 5 Real Effects – Impact on Firm Outcomes Associated with Banks' Exposure to the Energy Sector

This table reports the real effects associated with the reduction of lending to borrowers in the non-energy sector, given their bank's exposure to the energy sector. Observations are at the firm-year level. All observations are in logs of thousands of pesos. *Bank Liabilities*$_{,y}$ is the value of bank loans of firm *f* in year *y*. *Working Capital*$_{f,y}$ and *Investment*$_{f,y}$ are the value of the bank loans of firm *f* in year *y* to working capital and investment, respectively. *Total Liabilities*$_{f,y}$ is the value of a firm's total liabilities of firm *f* in year *y*. *Assets*$_{f,y}$ is the value of firm *f*'s total assets in year *y*. *Revenue*$_{f,y}$ is the value of firm *f*'s sales in year *y*. *Post*$_{y}$ is an indicator variable that equals 1 after 2014. *AvgExposureEnergy*$_{m,Aug14}$ is the average exposure to the energy sector in August 2014, weighted by loan value in the municipality, of the banks operating in municipality *m* in which firm *f* resides. It proxies the impact at the municipality level of the decline in energy prices through banks that operate in it. Standard errors are clustered at the firm level. Detailed variable definitions are provided in Table A1. The sample period is from 2013 to 2016. *** p<0.01, ** p<0.05, * p<0.1.

	Total Lending$_{f,y}$	Working Capital$_{f,y}$	Investment$_{f,y}$	Total Liabilities$_{f,y}$	Assets$_{f,y}$	Revenue$_{f,y}$
	(1)	(2)	(3)	(4)	(5)	(6)
AvgExposureEnergy$_{m,Aug14}$*Post$_{y}$	-1.00**	-0.88*	-5.90***	-1.37**	-1.24***	-0.55
	(0.48)	(0.50)	(1.56)	(0.60)	(0.47)	(0.96)
Observations	122,157	118,581	12,022	1,115	1,239	1,236
R-squared	0.85	0.84	0.86	0.99	1.00	0.98
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector-year FE	No	No	No	No	No	No
SD(AvgExposureEnergy$_{m,Aug14}$)	2.1	2.1	2.1	2.1	2.1	2.1

Table 6 - Impact on States' Output Associated with Banks' Exposure to the Energy Sector

This table reports the results of a regression testing whether activity is impacted by the degree of exposure that states had to banks that were lending to the energy sector. Observations are at the state-quarter level. $GDP_{s,q}$ is the log index—relative to January 2004—of state *s*'s GDP in quarter *q*. We further split this indicator by type of sector (primary, secondary, and tertiary). *Primary* sector includes mining and agriculture, *Secondary* includes manufacturing and construction, and *Tertiary* includes services. $AvgExposureEnergy_{s,Aug14}$ is the average exposure to the energy sector in August 2014, weighted by loan value in the state, of the banks operating in state *s*. It proxies for the impact at the state level of the decline in energy prices through banks that operate in it. Columns indicating *Non-Energy* refer to states that are non-producers of energy. Standard errors are clustered at the state level. Detailed variable definitions are provided in Table A1. The sample period is from the first quarter of 2013 to the fourth quarter of 2016. *** p<0.01, ** p<0.05, * p<0.1.

	$GDP_{s,q}$		GDP $Primary_{s,q}$		GDP $Secondary_{s,q}$		GDP $Tertiary_{s,q}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$AvgExposureEnergy_{s,Aug14}*Post_q$	-0.67*	-1.14***	-3.67*	-2.94	-1.92**	-2.44***	-0.17	-0.30
	(0.42)	(0.36)	(2.19)	(2.32)	(0.85)	(0.85)	(0.28)	(0.27)
Observations	512	480	512	480	512	480	512	480
R-squared	0.69	0.77	0.31	0.32	0.51	0.53	0.82	0.86
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
States	All	Non-Energy	All	Non-Energy	All	Non-Energy	All	Non-Energy
SD($AvgExposureEnergy_{s,Aug14}$)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6

Appendix

Figure A1 – Energy Prices and Firm Leverage

This figure displays the bank-level share of lending to the energy sector in Mexico from 2013Q1 to 2016Q2.

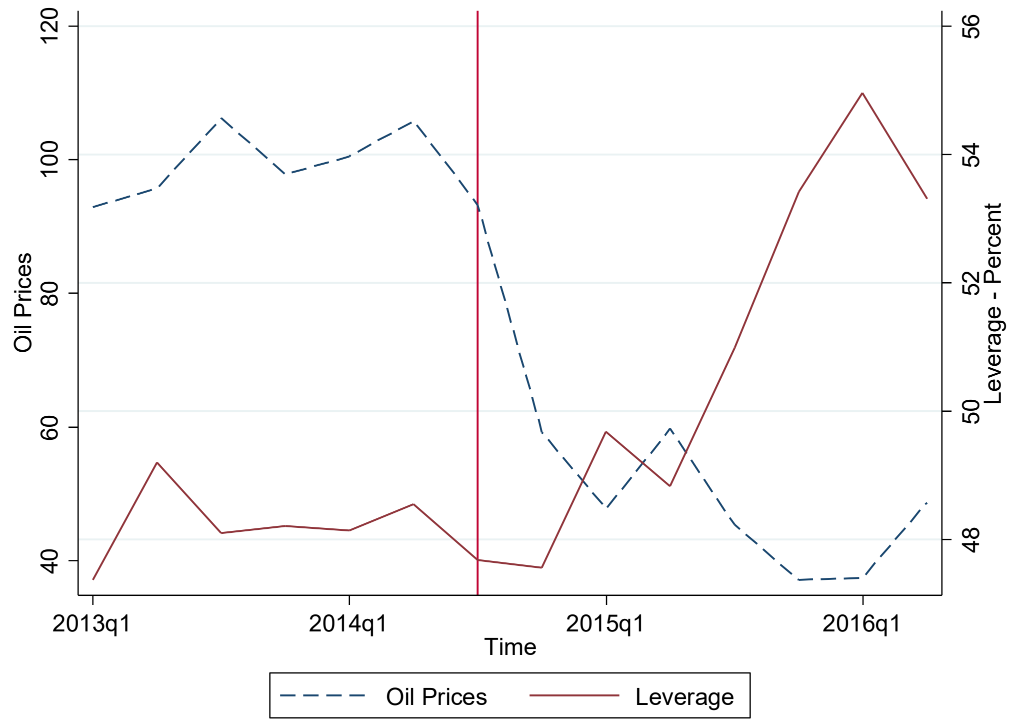

Figure A2 –Loan Size Pre-Shock and Loan Size Growth

This figure displays a bin scatter plot for the sample of firms in the energy sector. The figure relates the loan volume of firms in the month prior to the price shock to ex post loan volume growth. Therefore, loans on the x-axis are grouped by size. *Log Total Lending – Pre-Shock* is the log value of the total loans outstanding in August 2014. We have censored the energy sample of all firm-bank loans above the 90th percentile. *Log Loan Growth* is the average growth rate of loan volume (in percent) from August 2014 to August 2016.

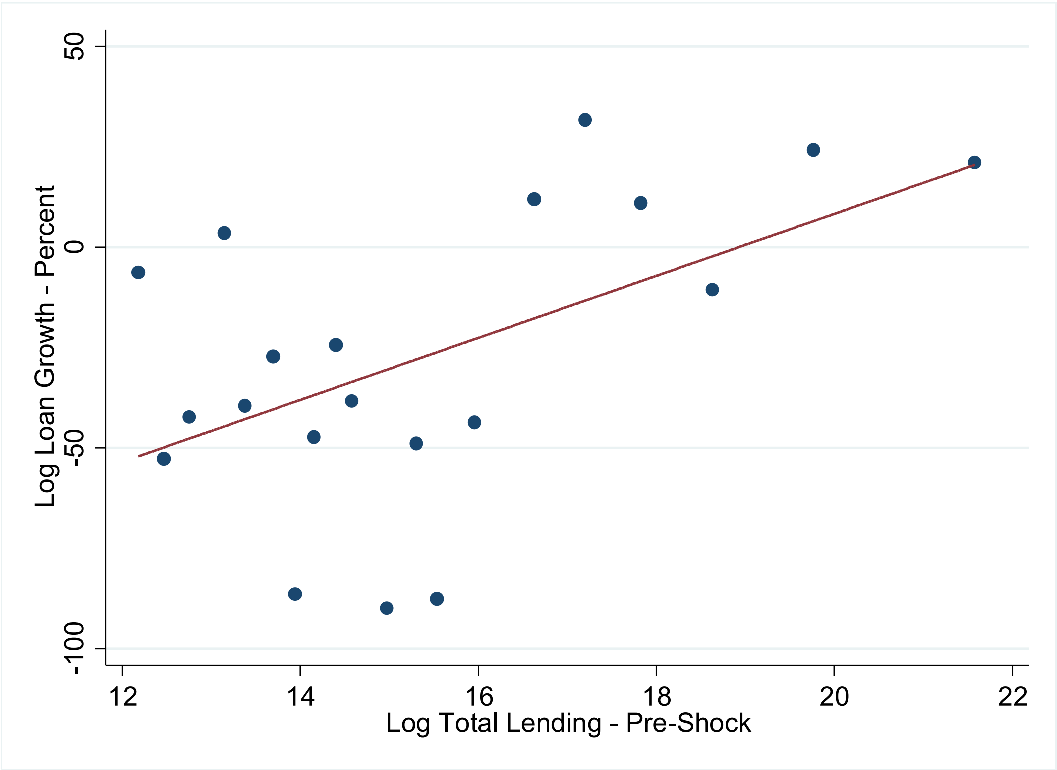

Table A1. Variable Definitions

Bank variables	
$\text{ExposureEnergy}_{b,m}$	Share of lending of bank *b* to borrowers operating in the energy sector in month *m* (percent)
$\text{Tier 1 Capital Ratio}_{b,m}$	Ratio of a bank's core equity capital to its total risk-weighted assets in month *m* (percent)
$\text{Total Lending}_{b,m}$	Total credit portfolio of commercial loans of bank *b* in month *m* (logs of millions of Mexican pesos)
$\text{Delinquency}_{b,m}$	Average ratio of nonperforming loans of bank *b* to total loans in month *m* (percent)
$\text{CDS}_{b,m}$	Five-year CDS spread of bank *b* in month *m* minus sovereign CDS spread of bank *b*'s country (percent relative to August 2014)
$\text{Stock Price}_{b,m}$	Stock price of bank *b* in month *m* (percent relative to August 2014)
$\text{ExposureEnergy}_{b,Aug14}$	Share of lending of bank *b* to borrowers operating in the energy sector in August 2014 (percent), weighted by number observations
Loan variables	
$\text{Total Lending}_{f,b,m}$	Value of outstanding loans of firm *f* with bank *b* in month *m* (logs of thousands of Mexican pesos)
$\text{Working Capital}_{f,b,m}$	Value of outstanding working capital loans of firm *f* with bank *b* in month *m* (logs of thousands of Mexican pesos)
$\text{Investment}_{f,b,m}$	Value of outstanding investment loans of firm *f* with bank *b* in month *m* (logs of thousands of Mexican pesos)
$\text{Interest Rate}_{f,b,m}$	Average interest rate of loans of firm *f* with bank *b* in month *m*, weighted by loan value (percent)
$\text{Maturity}_{f,b,m}$	Average maturity of loans of firm *f* with bank *b* in month *m*, weighted by loan value (years)
$\text{Collateral}_{f,b,m}$	Fraction of loans with guarantees of firm *f* with bank *b* in month *m*, weighted by loan value (percent)
$\text{ExposureEnergy}_{b,Aug14}$	Share of lending of bank *b* to borrowers operating in the energy sector in August 2014, weighted by number observations (percent)
Firm variables	
$\text{Total Lending}_{f,y}$	Total bank loans of firm *f* in year *y* (logs of thousands of Mexican pesos)
- Working $\text{Capital}_{f,y}$	Total value of working capital bank loans of firm *f* in year *y* (logs of thousands of Mexican pesos)
- $\text{Investment}_{f,y}$	Total value of investment bank loans of firm *f* in year *y* (logs of thousands of Mexican pesos)
$\text{ExposureEnergy}_{f,Aug14}$	Average exposure of banks to the energy sector in August 2014 of banks serving firm *f*, weighted by loans in municipality (percent)
$\text{Liabilities}_{f,y}$	Total liabilities of firm *f* in year *y* (logs of thousands of Mexican pesos)
$\text{Assets}_{f,y}$	Total assets of firm *f* in year *y* (logs of thousands of Mexican pesos)
$\text{Revenues}_{f,y}$	Total operational revenue of firm *f* in year *y* (logs of thousands of Mexican pesos)
Small firm_{f}	Indicator that firm *f* had fewer than 50 employees in 2014
$\text{ExposureEnergy}_{m,Aug14}$	Average of exposure to the energy sector in August 2014 of banks serving municipality *m*, weighted by loans in municipality (percent)
State variables	
$\text{ExposureEnergyState}_{s,q}$	Share of lending to the energy sector of banks operating in state *s* in quarter *q*, weighted by banks' loan portfolio (percent)
$\text{Total GDP}_{s,q}$	GDP of state *s* in quarter *q* (index relative to 2014)
$\text{ExposureEnergy}_{s,Aug14}$	Exposure of banks to the energy sector in August 2014 in the state of firm *f*, weighted by loans in the state (percent)

Note: CDS = credit default sway; GDP = gross domestic product.

Table A2 – Bank Comparison, Given Exposure to the Energy Sector

This table displays the 5-digit NAICS energy-related sectors as well as their descriptions. NAICS = North American Industry Classification System.

5-digit NAICS sector	Description
21111	Oil and gas extraction
21211	Coal mining
21311	Support activities for mining and oil and gas extraction
23712	Oil and gas pipeline related structures construction
32411	Petroleum refineries
32419	All other petroleum and coal products manufacturing
32511	Petrochemical manufacturing
48311	Marine oil and natural gas transportation
48611	Transportation of crude oil through pipelines
48621	Transportation of natural gas through pipelines
48691	Pipeline transportation of refined petroleum products

Table A3 – Testing for Pre-Trends, Given Exposure to the Energy Sector in August 2014

This table tests for the existence of pre-trends across banks with varying exposures to the energy sector in June 2014 on a series of bank-level characteristics. Observations are at the bank-month level. Dependent variables are listed in the columns. $Loans_{b,m}$ are total monthly loans of bank *b* in logs. $CDS\ Spreads_{b,m}$ is the log of CDS spreads of five-year maturity bonds of bank *b* in month *m*. $Stock\ Price_{b,m}$ is the log of the stock price of bank *b* in month *m*. $Delinquency_{b,m}$ is the share of delinquent loans of bank *b* in month *m*. $ExposureEnergy_{b,m}$ represents lending to the energy sector of bank *b* as a share of its tier 1 capital in month *m*. Standard errors are double clustered at the bank and month levels. Detailed variable definitions are provided in Table A1. The sample period is from January 2013 to August 2014. *** p<0.01, ** p<0.05, * p<0.1.

	$ExposureEnergy_{b,m}$		$Total\ Lending_{b,m}$		$CDS\ Spreads_{b,m}$		$Stock\ Price_{b,m}$		$Delinquency_{b,m}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$ExposureEnergy_{b,Aug14}$	0.333***		0.001		-0.032		-0.015		-0.027	
	(0.103)		(0.029)		(0.032)		(0.047)		(0.023)	
$ExposureEnergy_{b,Aug14}*Trend_m$	0.006	0.004	-0.000	-0.000	0.003	0.003	-0.000	-0.000	0.001	0.001
	(0.009)	(0.003)	(0.003)	(0.000)	(0.002)	(0.002)	(0.004)	(0.000)	(0.003)	(0.001)
Observations	306	306	306	306	124	124	170	170	306	306
R-squared	0.362	0.946	0.163	0.996	0.205	0.817	0.006	0.998	0.046	0.863
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
$SD(ExposureEnergy_{b,Aug14})$	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5

Table A4 – Testing for Pre-Trends, Given Exposure to the Energy Sector in August 2014

This table tests for the existence of pre-trends in loans to firms in the energy sector, given the exposure of banks to the energy sector in August 2014. The sample period is from January 2013 to August 2014. The dependent variables are in logs. $Total\ Lending_{f,b,m}$ is the total lending value to firm *f* by bank *b* in month *m*. $Working\ Capital_{f,b,m}$ and $Investment_{f,b,m}$ are total lending value destined to working capital and investment, respectively. The sample is at the firm-bank-month level of observation. Standard errors are double clustered at the bank and month levels. *** p<0.01, ** p<0.05, * p<0.1.

	$\text{Total Lending}_{f,b,m}$		$\text{Working Capital}_{f,b,m}$		$\text{Investment}_{f,b,m}$	
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{ExposureEnergy}_{b,Aug14}$	-0.018		-0.058*		0.035	
	(0.025)		(0.030)		(0.056)	
$\text{ExposureEnergy}_{b,Aug14}\text{*TimeTrend}_{b,m}$	0.001	0.001	0.001	0.002	0.001	0.001
	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
Observations	7,160	7,160	7,160	7,160	7,160	7,160
R-squared	0.001	0.058	0.004	0.045	0.004	0.090
Bank-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	-	Yes	-	Yes	-
Firm-month FE	No	Yes	No	Yes	No	Yes
$\text{SD(ExposureEnergy}_{b,Aug14})$	6.2	6.2	6.2	6.2	6.2	6.2

Table A5. - Lending Volume to the Energy Sector, Given Bank Exposure to Energy Sector Firms

In this panel, we display the impact of bank exposure to the energy sector on its lending to energy sector borrowers, given the exposure of the bank relative to the borrower. We divide the sample of loans into *Small* or *Large* based on whether their value in August 2014 is above or below the median weighted by loan size. The dependent variables are in logs. $Total\ Lending_{f,b,m}$ is the total lending volume to firm f by bank b in month m. $Working\ Capital_{f,b,m}$ and $Investment_{f,b,m}$ are total lending volume destined to working capital and investment, respectively. $ExposureEnergy_{b,201409}$ is the ratio of lending to the energy sector of bank b in September 2014 to its tier 1 capital. $Post_m$ is an indicator that the observation is after September 2014. Standard errors are clustered at the state*month level. Detailed variable definitions are provided in Table A1. Observations are at the firm-bank-month level and the sample period is from January 2013 to December 2016. *** p<0.01, ** p<0.05, * p<0.1.

	$Total\ Lending_{f,b,m}$		$Working\ Capital_{f,b,m}$		$Investment_{f,b,m}$	
	(1)	(2)	(3)	(4)	(5)	(6)
$ExposureEnergy_{b,Aug14}*Post_m$	0.00	0.02*	0.00	0.03*	-0.00	0.01
	(0.00)	(0.01)	(0.00)	(0.02)	(0.02)	(0.03)
Observations	20,610	3,353	19,721	2,932	1,486	890
R-squared	0.78	0.84	0.80	0.88	0.81	0.66
Bank-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Loan size pre-shock	Small	Large	Small	Large	Small	Large
SD($ExposureEnergy_{b,Aug14}$)	6.2	6.2	6.2	6.2	6.2	6.2

Table A6. Alternative Measures of Bank Exposure to the Energy Sector

In this panel, we display the main estimates of a regression of total bank lending on bank exposure to firms in the energy sector, under four alternative bank exposure variables: (i) energy sector loans divided by total loans, (ii) energy sector loans divided by total assets, (iii) energy sector loans divided by total bank equity, and (iv) energy sector loans divided by the tier 1 ratio in December 2012. The top panel displays the results for the energy sector, and the bottom panel displays the results for the non-energy sector. The dependent variable in all regressions is the total lending volume (in logs) to firm *f* by bank *b* in month *m*. $Post_m$ is an indicator that the observation is after August 2014. Standard errors are clustered at the bank*month level. Detailed variable definitions are provided in Table A1. Observations are at the firm-bank-month level and the sample period is from January 2013 to June 2016. *** p<0.01, ** p<0.05, * p<0.1.

Energy sector	Total $Lending_{f,b,m}$			
	(1)	(2)	(3)	(4)
$ExposureEnergy_{b,Aug14}$*$Post_m$	0.028*	0.136	0.098***	0.045*
	(0.015)	(0.104)	(0.029)	(0.026)
Observations	6,994	6,994	6,994	6,994
R-squared	0.947	0.947	0.948	0.947
Bank-firm FE	Yes	Yes	Yes	Yes
Firm-month FE	Yes	Yes	Yes	Yes
SD($ExposureEnergy_{b,Aug14}$)	6.2	6.2	6.2	6.2

Non-energy sector	Total $Lending_{f,b,m}$			
	(1)	(2)	(3)	(4)
$ExposureEnergy_{b,Aug14}$*$Post_m$	-0.012***	-0.131***	-0.033***	-0.006*
	(0.002)	(0.023)	(0.006)	(0.003)
Observations	1,262,640	1,262,640	1,262,640	1,262,640
R-squared	0.795	0.795	0.795	0.794
Bank-firm FE	Yes	Yes	Yes	Yes
Firm-month FE	Yes	Yes	Yes	Yes
SD($ExposureEnergy_{b,Aug14}$)	6.1	6.1	6.1	6.1