

Trade Shocks and Credit Reallocation[†]

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This paper identifies a credit-supply contraction that arises endogenously after trade liberalization. Banks with loan portfolios concentrated in sectors exposed to competition from China face an increase in nonperforming loans after China's entry into the World Trade Organization. As a result, they reduce the supply of credit to firms, irrespective of the firm's sector of operation. This cut in credit translates into lower employment, investment, and output. Through this mechanism, the financial channel amplifies the shock to firms already hit by import competition from China and passes it on to firms in sectors expected to expand upon trade liberalization. (JEL D22, F14, G21, G31, G32, L25, P33)

Trade liberalization has heterogeneous effects across economic sectors and, correspondingly, across regions or factors of production according to their exposure to affected economic activities.¹ In this paper, we show commercial banks are also exposed to trade shocks, based on the concentration of their loan portfolios in distinct activities. As a result, a liberalization episode triggers a lending channel response. Firms related to more exposed banks suffer credit tightening, with consequences on employment and investment that go beyond the direct effect of the rise in import competition.

The originating trade shock in our analysis is the entry of China into the World Trade Organization (WTO). In Italy, the share of imports from China more than doubled between 2002 and 2007 (Figure 1, panel A); sectors most exposed to import competition from China suffered a 12 percent decline in employment during that

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¹See, among others, Topalova (2010); Menezes-Filho and Muendler (2011); Autor, Dorn, and Hanson (2013); Kovak (2013); Dix-Carneiro (2014); Autor et al. (2014); Acemoglu et al. (2016); Hakobyan and McLaren (2016); Dix-Carneiro and Kovak (2017); Utar (2018).

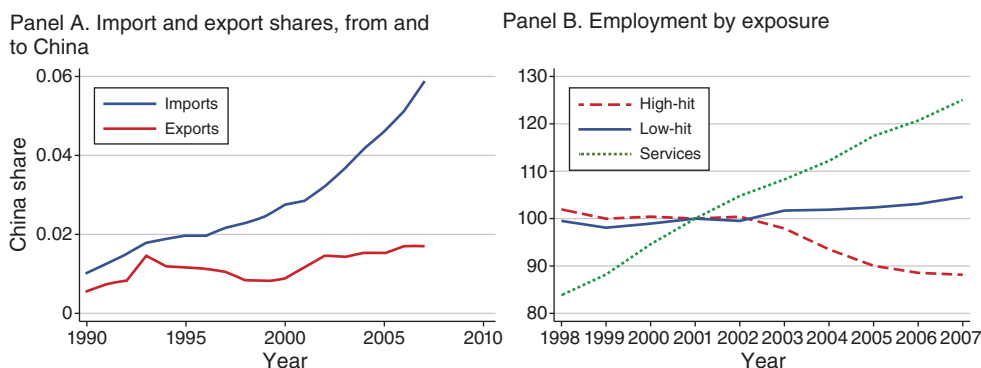


FIGURE 1. THE CHINA SHOCK: AGGREGATE PATTERNS OF TRADE AND EMPLOYMENT

Notes: Panel A shows the evolution of the share of exports and imports of Italy to and from China relative to total Italian exports and imports (ISTAT 1990–2007). Panel B shows the evolution of employment in services and in manufacturing sectors with high versus low exposure to import competition from China (2001 = 100). We compute sectoral exposure to China following the approach by Autor, Dorn, and Hanson (2013) and then define high- and low-hit sectors as the ones above and below the median. Sectoral employment data come from Eurostat (1998–2007).

period, while the other sectors remained unaffected (Figure 1, panel B). At the same time, nonperforming loans (NPLs) almost doubled among firms competing with imports from China, from €3.4 billion to €6 billion. This increase was large enough to erode banks' capital, which was €56 billion for the whole banking system at the onset of the shock. As a result, banks more exposed to these highly hit sectors cut their supply of credit to firms negatively affected by import competition from China and to firms in noncompeting sectors. In this way, banks amplified the effect of the liberalization shock to highly hit sectors and transmitted the negative effect toward sectors expected to expand.

Our analysis starts by measuring, for each sector of economic activity, the rise in imports per worker from China, along the lines of Autor, Dorn, and Hanson (2013). We then compute bank exposure to the China shock by looking at the share of loans to firms across sectors that are heterogeneously hit by the trade shock. To do so, we rely on the credit registry data for Italy and match it to the universe of banks and incorporated firms between 1998 and 2007.

Banks in our sample are specialized in economic activities along the lines described by Paravisini, Rappoport, and Schnabl (2023). Banks' balance sheets are therefore affected when their main sectors of lending suffer a negative shock. We find a 1 standard deviation higher bank exposure to the trade shock is associated with a 0.3 percentage point increase in the NPL share relative to banks' assets. This effect is sizable given that the NPL ratio for the median bank in those years is 1.4 percent. Importantly, we do not observe any reaction in deposits or external capital injections. This lack of reaction coincides with the predictions of classical banking models as in Froot, Scharfstein, and Stein (1993); Holmström and Tirole (1997); Froot and Stein (1998); and Deyoung et al. (2015). In such frameworks, banks' losses cannot be immediately restored, due to costs in raising external capital, and they lead to a contraction in credit supply, as we observe in our setting.

We analyze the patterns of credit supply before and after China's entry into the WTO, across banks with different degrees of exposure to negatively affected sectors. To establish the causal effect of bank exposure on credit supply, we use the Khwaja and Mian (2008) within-firm estimator. The firm-time fixed effects absorb any firm-wide innovation that equally affects credit by all related banks, for example, firm-wide changes in credit demand due to the China trade shock itself. We find that 1 standard deviation of bank exposure implies 7.4 percent lower credit supply and a 0.5 percentage points higher interest rate after 2002, relative to other banks lending to the same firm. This effect diminishes with the *ex ante* level of bank capitalization, which we interpret as a (inverse) measure of tightness of their lending capacity. Linearly extrapolating this heterogeneous effect, our results suggest that the increase in NPLs triggered by the China trade shock is decoupled from their lending capacity for banks with a tier 1 capital ratio above 14 percent. These banks, however, only account for less than 5 percent of total corporate credit.

Bank specialization in lending is not complete, which results in spillovers between borrowers operating in different industries. We find more exposed banks cut credit by a similar proportion both to firms subject to competition from China and to firms in sectors not directly affected by the trade shock. They also reduce credit supply to potential winners of the liberalization episode, that is, firms in sectors where Italy has a comparative advantage, highly productive firms, and even those that are more likely to benefit from cheaper inputs from China (downstream industries).

We follow the effect of this newly identified financial channel on firms' outcomes. First, we compare total credit of firms that, prior to 2001, borrowed from exposed banks with total credit of firms in the same four-digit sector borrowing from less constrained sources. A firm with 10 percent higher exposure to this liberalization-triggered financial channel had 6 percent lower credit. In line with previous literature, we therefore conclude, firms cannot easily substitute across sources of funding in the aftermath of a credit-supply shock.

Second, we estimate how this credit shock affected firms' real outcomes. On average, 10 percent higher exposure to the financial channel resulted in about 4 percent to 6 percent lower employment, investment, and revenue growth, relative to other firms in the same sector borrowing from less exposed banks, with a substantially higher impact among firms in manufacturing sectors that overlap with the rise in imports from China: For these firms, a 10 percent higher exposure resulted in 10 percent lower employment growth, and, for investment and revenue growth, these figures increase to 11 percent and 12 percent, respectively.

To account for both the sensitivity of firms in different sectors to the credit shock and their dependence on exposed banks, we follow Chodorow-Reich (2014) and compute a *partial equilibrium aggregation*. Without accounting for general equilibrium responses, we measure the direct impact of the lending channel on employment. In sectors already hit by import competition, the growth rate of employment between 2002 and 2007 could have been 2.9 percentage points higher if the bank lending channel were not binding, namely, 80,000 job losses, almost one-fourth of the overall jobs losses in these sectors. Exposed banks also transmitted the shock to services and manufacturing sectors not competing with imports from China. In those sectors, employment growth, which was positive in the aftermath of the trade shock, would have been 1.3 percentage points higher absent credit restrictions.

We also explore the geographical dimension of the bank lending channel.² Using information on the location and size of firms, we estimate the geographical concentration of sectors most hit by the increase in imports. We find our results apply across provinces, including those with lower exposure to the shock. This finding suggests the endogenous credit contraction by exposed banks, triggered by the increase in imports from China, propagated nationally, affecting firms beyond any potential local general equilibrium effect on labor or nontradables markets. Although, due to mobility frictions, labor market effects tend to be localized (see, e.g., Autor, Dorn, and Hanson 2013 and Hakobyan and McLaren 2016), the bank credit-channel is nationally diffused because banks operate in multiple regions.

This paper contributes to different strands of the literature. First, it is linked to the core question of how the economy adjusts to trade shocks. This literature has largely focused on the (slow) reallocation of workers across sectors.³ Evidence on capital reallocation after trade shocks is limited, even though, as Dix-Carneiro (2014) argues, quantifying the mobility of capital and its interaction with labor-mobility frictions is essential to understanding the full transitional dynamics of the economy after a trade shock. Notable exceptions are Antràs and Caballero (2009), who focus on the effects of a trade shock on international capital flows across countries; Lanteri, Medina, and Tan (2023), who examine the reallocation of machines and physical capital in Peru in the aftermath of China's entry into the WTO; and Mayordomo and Rachedi (2022), who look at the effect of the China shock on Spanish banks.

Finally, our paper is also related to the literature on the financial and real implications of shocks to banks.⁴ In this literature, the identification strategy largely relies on shocks that directly affect the financial sector. Instead, the shock to banks in our analysis comes from the performance of firms in the real sector. This finding allows us to learn not only about the consequences of the trade shock under study but also about how real shocks spread into the general economy.

The rest of the paper is structured as follows. Section I describes the data. Section II analyzes the effect of the liberalization shock on banks' credit supply. Section III estimates the effect of these credit restrictions on firms' output, investment, and employment. Section IV focuses on the mechanism behind our findings. Section V discusses alternative mechanisms and the robustness of our results. Finally, Section VI concludes.

²This is related to the literature on geographical transmission of liquidity shocks. See, among others, Allen and Gale (2000); Kaminsky and Reinhart (2000); Gilje, Loutskina, Strahan (2016); Cortés and Strahan (2017); Byun, Lee, and Lee (2021); and Bustos, Garber, and Ponticelli (2020). Giroud and Mueller (2019) study how firms' internal networks propagate shocks across counties.

³See, among others, Menezes-Filho and Muendler (2011); Autor et al. (2014); Acemoglu et al. (2016); Dix-Carneiro (2014); and Utar (2018); or across regions in Aghion et al. (2008); Topalova (2010); Autor, Dorn, and Hanson (2013); Kovak (2013); Hakobyan and McLaren (2016); and Dix-Carneiro and Kovak (2017).

⁴See, among others, Peek and Rosengren (2000); Gan (2007); Khwaja and Mian (2008); Paravisini (2008); Amiti and Weinstein (2011, 2018); Schnabl (2012); Chodorow-Reich (2014); Paravisini et al. (2015); Baskaya and Kalemli-Ozcan (2016); Cingano, Manaresi, and Sette (2016); Huber (2018); Jiménez et al. (2020); Martín, Moral-Benito, and Schmitz (2021); Cingano and Hassan (2022).

I. Data and Measurement

A. Data Sources

Our analysis is based on a matched bank-firm dataset containing loans for a large sample of Italian companies. We obtain the final dataset by combining four sources: credit registry, banks' balance sheet data, firms' balance sheet data, and world bilateral imports by product.

The first source is the Italian Credit Register administered by the Banca d'Italia, which contains a monthly panel of the outstanding debt of every borrower (firms or individuals) with loans above €75,000 with each bank operating in Italy (Banca d'Italia 1998–2007a). We focus on corporate borrowers and build an annual bank-firm panel, where loans are measured as the outstanding credit (committed credit lines and fixed-term loans) granted at the end of a given year.

Banks' balance sheet data are from the Banca d'Italia Supervisory Reports, which provide detailed data on banks' assets and liabilities (Banca d'Italia 1998–2007b). Firms' balance sheet data (including variables such as revenues, investment, employment, and wage bill) are taken from the CERVED (1998–2007) database, which covers the universe of incorporated firms in Italy.⁵ We match the bank-firm loan data to banks' and firms' balance sheet data, using unique bank and firm identifiers, respectively.

Finally, we use data from the COMTRADE on imports from China at the six-digit Harmonized System (HS) product level for Italy and other advanced economies.⁶ We convert the product classification to the more aggregate NACE four-digit, using concordance tables provided by Eurostat (n.d.). This information is needed to identify the exposure of firms and banks (via their loan portfolio) to the China shock (see Section IB).

Table 1 shows the summary statistics of bank and firm characteristics in our sample. The unit of observation in our empirical analysis is at the bank-firm annual level. The dataset includes, on average, 504 banks and about 170,000 firms, of which 70,000 are in manufacturing.⁷ Italian firms usually borrow from multiple banks, even small firms (Detragiache, Garella, and Guiso 2000). About 68 percent of firms in our sample borrow from 2 or more banks (75 percent in manufacturing), and these firms account for 90 percent of total credit and 84 percent of employment. The average number of banking relationships for firms with multiple lenders is 4.5. As we discuss in the following sections, we use the fact that firms borrow from multiple banks in our identification strategy.

⁵ Incorporated firms from CERVED account for 70 percent of value added in manufacturing and services from national accounts, and the trend follows the national one closely.

⁶ We take the countries in the original paper of Autor, Dorn, and Hanson (2013): the United States, Australia, Denmark, Finland, France, Germany, Japan, New Zealand, Switzerland, and Spain. We focus on the extra-European countries for our baseline instrument.

⁷ We consolidate all bank-level variables and firm-bank credit at the banking group level, and, as it is standard in the literature, we account for mergers and acquisitions by taking the 2007 groups' structure and building it back to 1998 (i.e., if bank 1 and bank 2 merged in 2003, they are treated as one bank since 1998).

TABLE 1—SUMMARY STATISTICS

	Unit	Mean	SD	p25	p50	p75
<i>Bank characteristics</i> (Observations = 504)						
Total assets	€Millions	4,701	36,002	109	229	535
Liquid assets	% Assets	30.5	14.1	21.8	27.9	37.9
Nonperforming loans	% Assets	2.6	2.6	1.1	1.9	3.3
Credit to firms	% Assets	37.6	13.1	28.8	39.3	47.3
Profits	% Assets	1	0.5	0.7	1	1.2
Tier 1 capital	% R.W. Assets	10	4.4	7.0	9.1	11.8
Core funding	% Liabilities	52.5	17.7	44.4	51.9	64.4
Operating provinces	Number	15	22	4	7	14
Bank exposure to China	Weighted average of borrowers' exposure	0.89	0.76	0.34	0.76	1.21
<i>Firm characteristics</i> (Observations = 170,265; manufacturing: 70,339; services: 99,926)						
Bank credit	€Millions	2.3	16.6	0.32	0.70	1.7
Revenues	€Thousands	4,929	5,962	1,076	2,363	5,925
Fixed assets	€Thousands	984	1,548	97	322	1,045
Gross operating margin	% Revenues	8.0	6.8	3.8	6.1	9.8
Credit score	Units	5.0	1.9	4.0	5.0	7.0

Notes: The table reports averages for 1998–2007. Bank balance sheet data are from the Supervisory Reports-Banca d'Italia. Credit data are from the Italian Credit Register. Firm balance sheet data are from CERVED (1998–2007). Liquid assets include cash, interbank deposits, and bond holdings. Core funding refers to deposits. Firms' credit score is computed by CERVED based on past defaults and firms' balance sheet information.

B. Defining Firm and Bank Exposure to the China Shock

For our empirical strategy, we first need to identify firms' direct exposure to the increase in import competition from China. We closely follow Autor, Dorn, and Hanson (2013) in their empirical strategy and compute the following sector-level (four-digit) measure of exposure to the China shock⁸:

$$(1) \quad \text{China}_s^{IT} = \frac{\Delta M_s^{IT-CH}}{L_{s,1991}^{IT}}.$$

The numerator is the difference in Italy's imports from China in a given four-digit NACE sector s between the years before and after China's entry to WTO (2002–2007 average versus 1994–2001 average).⁹ The denominator corresponds to the employment level in the same sector in 1991.¹⁰ According to this measure, the five sectors with the highest exposure to the China shock are “Coke oven products,” “Watches and clocks,” “Television and radio receivers,” “Games and toys,” and “Other organic basic chemicals.” The least exposed sectors are instead “Aircraft and spacecraft,” “Carpets and rugs,” “Beer,” “Sugar,” and “Distilled alcoholic beverages.” Figure 2, panel A shows the distribution of exposure to China by sector, with its median cutoff.

⁸We exclude the oil and energy sectors, which are more volatile and subject to global fluctuations. If we include those sectors, all results hold.

⁹The results are robust to using the difference in imports between 1994 and 2007.

¹⁰We take the year 1991 because it is the one with census data (ISTAT 1991). The alternative census year would be 2001, but employment figures are less likely exogenous to the increase in imports from China.

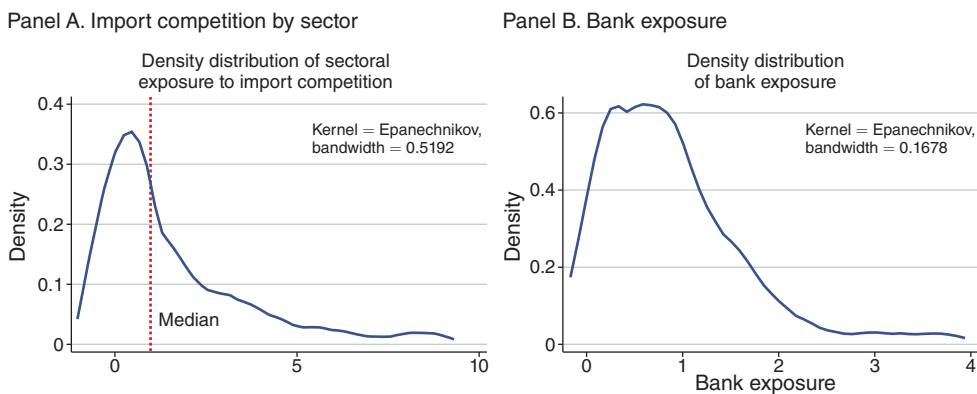


FIGURE 2. DISTRIBUTION OF SECTOR- AND BANK-LEVEL MEASURE OF EXPOSURE

Note: Panel A shows the distribution of exposure to China at the sectoral level as defined in (1); panel B shows the distribution of bank exposure to China as defined in equation (2) (without leaving out firm i from credit weights).

Manufacturing sectors above and below the median account for an equal share of total credit and employment in year 1991.

This sectoral measure of exposure is then applied to firms according to their reported main economic activity. Then, for each bank b (and firm i), we measure its exposure to the China shock as the weighted average of its borrowers' exposure (where the weights are given by the borrowers' share of loans in the bank's portfolio), leaving out firm i :¹¹

$$(2) \quad Exposure_{-ib}^{IT} = \frac{\sum_{i' \neq i} C_{i'b} China_{i's}^{IT}}{\sum_{i' \neq i} C_{i'b}},$$

where C_{ib} is the outstanding credit of bank b to a manufacturing firm i and, abusing notation, $China_{i's}^{IT}$ corresponds to the measure of exposure defined in (1) for the main sector of activity of firm i .

The results are robust to alternative definitions of firm and bank exposure to the shock.¹² To attenuate endogeneity issues and possible portfolio adjustments by banks in anticipation of China's entrance into the WTO, we measure banks' exposure, averaging the shares over the years 1998–1999. We prefer to average our measure of bank exposure over multiple years rather than a single year (e.g., 1998), so we avoid some bias that may arise from a year-specific shock at the beginning of the period.¹³

¹¹To avoid endogeneity with the dependent variable, this measure is constructed leaving out firm i . In our sample, credit to firm i is typically too small to affect the aggregate bank exposure: The median firm accounts for 0.001 percent of bank credit. As a robustness check, in the Supplemental Appendix, we also present the results when leaving out the firm's entire sector.

¹²As a robustness check, in the Supplemental Appendix, we measure bank exposure relative to bank total assets.

¹³We start from 1998 because it is the first year with data on banks' balance sheet in our sample. Our results are robust to including the year 2000 to compute banks' portfolio shares; results are available upon request.

Figure 2, panel B shows the distribution of this measure across banks. Banks in the top quartile of the distribution account for more than 80 percent of total credit. The overall credit to firms in sectors with above-median exposure to competition from China amounted to €184 billion at the onset of the shock (14 percent of GDP).

A standard concern is that Italy's imports from China might capture not only a pure "China supply" effect but also shocks to Italian demand for imports. In addition, measurement issues might exist because this measure does not account for Italian exports being affected by China supply factors (e.g., Italian exports to Germany that are now substituted by Chinese exports to Germany). Following Autor, Dorn, and Hanson (2013), we instrument the trade shock using the variation in imports from China to a set of advanced economies outside Europe (ΔM_s^{OC}). Specifically, we compute an industry-level measure of exposure to the China shock based on imports from China to a group of "other countries" ($China_s^{OC}$)¹⁴:

$$(3) \quad China_s^{OC} = \frac{\Delta M_s^{OC-CH}}{L_{s,1991}^{IT}}.$$

This instrumental approach aims to recover supply-side determinants of imports from China, rather than Italian local factors. The motivation for this instrument is that high-income economies are similarly exposed to growth in imports from China that is driven by Chinese supply shocks. However, the instrument relies on two key underlying assumptions: (i) Industry demand shocks should be uncorrelated across countries, and (ii) demand shocks from Italy do not trigger increasing returns to scale in Chinese manufacturing and do not induce them to export more to other high-income countries.

We then compute a measure of bank exposure that is exogenous to demand developments in Italy or Europe ($Exposure_{-ib}^{OC}$) and can therefore be used as an instrument in our estimation strategy. Moreover, this measure is also exogenous to Italian banks' supply of credit. In fact, although in principle, bank credit in Italy can affect Italian imports from China, it has little effect on imports to the United States from China:

$$(4) \quad Exposure_{-ib}^{OC} = \frac{\sum_{i' \neq i} C_{i'b} China_{i's}^{OC}}{\sum_{i' \neq i} C_{i'b}}.$$

Our measure of bank exposure focuses on the negative impact of China's entry into the WTO on firms in sectors *directly* hit by import competition. As a robustness check, we compute a measure of bank exposure that also considers the sectors that are *indirectly* hit through input-output linkages, namely, the sectors that sell inputs to the directly hit sectors.

¹⁴The countries in the baseline regression are the United States, Australia, Japan, and New Zealand (the extra-European countries in Autor, Dorn, and Hanson 2013). Results (shown in the Supplemental Appendix) are robust to the inclusion of European countries, as well as to using only Australia, Japan, and New Zealand or the United States separately.

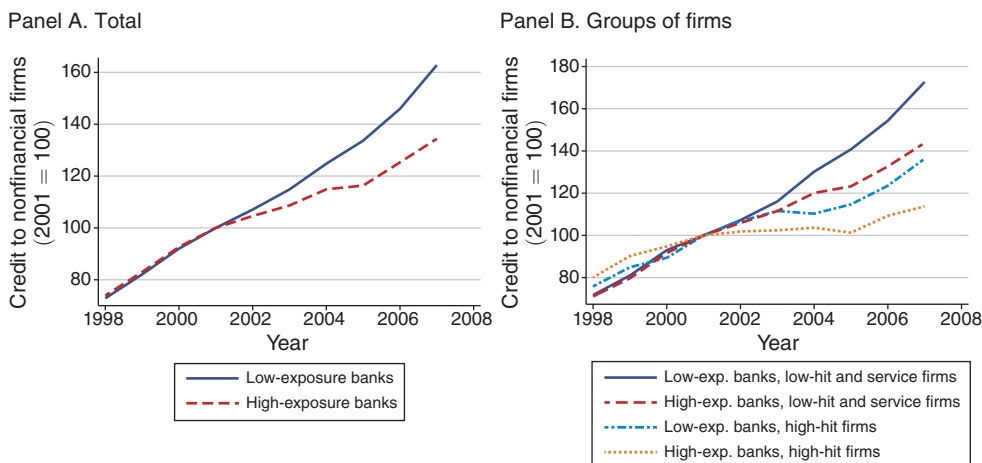


FIGURE 3. AGGREGATE CREDIT, BY BANK EXPOSURE

Notes: The figure reports the evolution of the total outstanding credit by bank exposure. We divide the sample of banks between high- and low-exposure according to (2), such that both groups account for about half of total credit. In panel B firms are defined to be high-hit or low-hit according to whether they are in a sector subject to China competition above or below the median as defined in equation (1).

Although the aggregate evolution of exports does not present a clear break around the time of China's entry into the WTO (Figure 1, panel A), some sectors and firms may have benefited from the liberalization episode. We exploit this heterogeneity in the next section to show banks' exposure to import competition negatively affected credit supply to these potentially expanding sectors.

II. Trade Shock and Banks' Credit Supply

In this section, we investigate the evolution of credit supply by banks that were relatively more exposed to the trade shock. We establish that banks suffering from this shock ended up restricting their supply of credit. We then analyze how these banks adjusted credit across sectors heterogeneously exposed to import competition from China.

A. Methodology

Figure 3, panel A compares the trends in aggregate lending to Italian companies between high-exposure banks (red dashed line) and low-exposure banks (blue continuous line). We select a threshold of banks' exposure so that each of the two groups accounts for half of the outstanding credit, and we use the non-leave-out version of equation (2). The two time series for aggregate credit are indexed to 100 at the end of 2001. Although lending growth was initially very similar across the two groups of banks, since 2002, the two trends start diverging: Lending by banks that were more exposed to the China shock grew significantly less than lending by less exposed banks. This diverging pattern can be the result of both supply and demand factors because firms subject to competition from China may shrink and

demand less credit, driving the aggregate pattern of more exposed banks. Therefore, Figure 3, panel B further disaggregates lending by the two groups of banks according to borrowers' characteristics. In particular, we distinguish between firms operating in manufacturing sectors above the median of exposure to import competition from China (High-Hit) and firms in manufacturing sectors of exposure below the median (Low-Hit) and in services. In this way, we can compare the lending patterns across banks with firms with a similar evolution of credit demand. The figure shows lending of highly exposed banks grew more slowly than lending of low-exposure banks for both groups of firms.

To formally establish the causal effect of bank exposure on credit supply, we use the Khwaja and Mian (2008) within-firm estimator. The results are driven by multibank firms, for which we can compare changes in credit across banks, for the same firm. As mentioned earlier, firms that borrow from multiple banks account for the bulk of total credit. For each bank-firm-year observation, our baseline specification is

$$(5) \quad \ln C_{ibt} = \beta_1 Exposure_{-i,b}^{IT} \times Post_t + \beta_2 Spec_{ibt} \times Post_t + \mathbf{X}_b' \boldsymbol{\delta} \times Post_t \\ + \alpha_{it} + \gamma_{ib} + \epsilon_{ibt}.$$

The dependent variable is the log of outstanding credit, C_{ibt} , granted by bank b to firm i at the end of year t . Our variable of interest is $Exposure_{-i,b}^{IT}$, the ex ante exposure of banks to borrowers competing with imports from China, instrumented with $Exposure_{-i,b}^{OC}$, defined using the imports from China into other non-European developed countries (equation (4)). The interaction dummy $Post_t$ is equal to 1 for the years after China's entry into the WTO (2002–2007), and 0 for the earlier years (1998–2001).

$\mathbf{X}_b$ is a vector of control variables (1998–1999 averages) of key bank attributes, interacted with a post-period dummy: the log-assets as a proxy of bank size; the share of NPLs, which captures bank performance and management; bank core liabilities, which control for the funding structure of the bank; and the capital ratio, which controls for the degree of bank leverage. We include a set of firm-bank fixed effects (γ_{ib}) that control for potential nonrandom matching between firms and banks and all time-invariant factors that may affect the loan level for any bank-firm pair. Finally, we add firm-year fixed effects (α_{it}) that capture any shock that hits firm credit in year t across all related banks, including the changes in import competition from China. Given that our source of variation is at the bank level and the original China shock is defined at the sectoral level, we cluster the standard errors at the bank-sector level.¹⁵ In the baseline specification, the observations are unweighted.¹⁶

¹⁵ As a robustness check, in the Supplemental Appendix, we report shift-share instrumental variable coefficients, where standard errors are obtained from equivalent industry-level regressions (as in Borusyak, Hull, and Jaravel 2022). We also present the results of a specification in which the definition of bank exposure does not include the firm's sector of operation.

¹⁶ To address concerns of autocorrelation (see Bertrand, Duflo, and Mullainathan 2004), we show in the Supplemental Appendix the estimation of equation (5) in first difference, taking the average of the pre- and post-period for the variables of interest. As a robustness check, in the Supplemental Appendix, we also show a specification with observations weighted by firms' employment.

Our empirical strategy identifies credit-supply shocks under the assumption that within-firm changes in credit demand across banks are uncorrelated with the banks' exposure to the China shock. This assumption would be violated, for example, if firms reduce credit demand disproportionately for banks specialized in sectors competing with China. To account for that possibility, we add a specialization dummy (interacted with $Post_t$) as in Paravisini, Rappoport, and Schnabl (2023) that takes the value of 1 if a bank is specialized in the sector of the firm.¹⁷

Our identification strategy is based on the exogeneity of the industry-level increases in Chinese exports, conditional on the abovementioned set of controls (i.e., the *shifts* in the *shift-share* instrument). Following Borusyak, Hull, and Jaravel (2022), we test this assumption by regressing selected pre-shock bank balance sheet and borrower characteristics on the (non-leave-out version of the) shift-share instrument. The results are reported in Figure 4. We find no statistically significant relationships, with just a few exceptions: Exposed banks are relatively larger (total assets are therefore included in the vector $\mathbf{X}_b$) and have a larger share of credit to firms but with fewer NPLs and provisions before the shock. Reassuringly, the borrower characteristics are not significantly correlated with the instrument.¹⁸

B. Banks' Credit Supply

Table 2 reports the OLS (column 1) and 2SLS (column 2) results.¹⁹ The coefficient of interest on bank exposure is statistically and quantitatively significant: A bank with a 1 standard deviation higher exposure reduces credit supply by 7.4 percent after China's entrance into the WTO relative to other banks lending to the same firm. The comparison between the coefficient on OLS and that on 2SLS suggests demand factors explain little of the overall change in Italian imports from China, or at least its effect on bank credit. We show in the Supplemental Appendix that the OLS bias is consistent with supply-driven factors explaining most of the volatility of Italian imports from China across sectors (weighted by banks' loans).

Columns 3 and 4 present the same specification using a different dependent variable: the interest rate bank b charges firm i in year t .²⁰ Only a subset of banks are required to report these data (130 banks, which account for 70 percent of total credit), resulting in a lower number of observations. Consistent with the results on credit amount (columns 1 and 2), we find banks more exposed to the China shock increased the interest rate relative to less exposed banks, for the same firm. A bank with a 1 standard deviation higher exposure increased the price of credit by 0.5 percentage points after China's entrance into the WTO, out of an average interest rate of 7 percent across firms in the post-2002 period.

Next, we exploit the panel structure of the data and estimate our coefficient of interest by year. This dynamic difference-in-differences estimator is plotted in

¹⁷ A bank is considered specialized in one sector if its share of loans in that sector is above the sum of the seventy-fifth percentile threshold and 1.5 the interquartile range across banks for a given sector-year.

¹⁸ Figure A.4 in the Supplemental Appendix reports the results of balancing tests on additional bank characteristics.

¹⁹ In the Supplemental Appendix, we show the results with different sets of controls and fixed effects.

²⁰ The interest rate is computed as the overall interests and fees payments from firm i to bank b (across all credit lines) relative to the overall amount of outstanding credit.

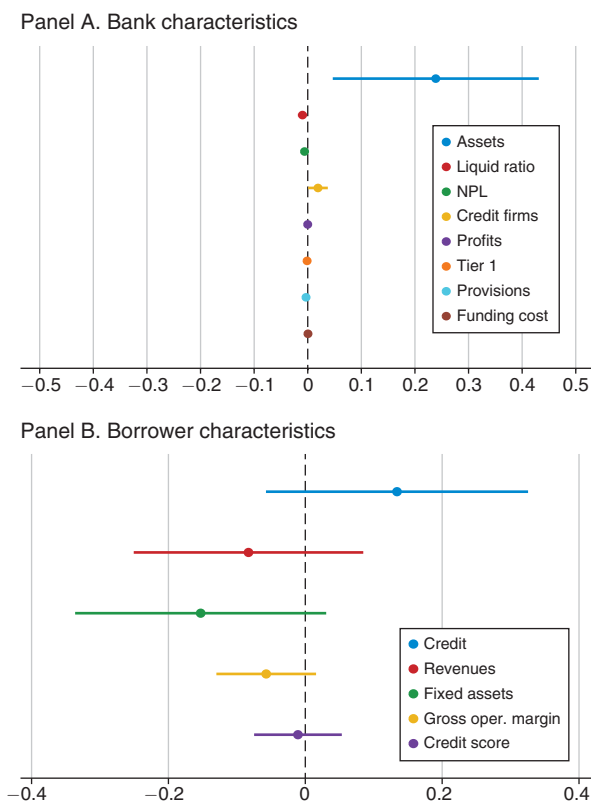


FIGURE 4. BALANCING TEST ON BANKS' AND BORROWERS' CHARACTERISTICS

Notes: The figure reports the results of regressions of bank and average borrower characteristics on the (non-leave-out version of) the shift-share instrument. Following Borusyak, Hull, and Jaravel (2022), the regressions are implemented at the shock level, in order to obtain exposure-robust standard errors.

Figure 5 for the full sample (panel A), for firms in low-hit sectors and services, and for firms in high-hit sectors (panels B and C, respectively). We verify that credit supply by banks heterogeneous in their level of exposure did not show different pre-trends prior to the trade-liberalization episode. If anything, for high-hit sectors, 2001 represented a break in an upward trend (although not statistically different from zero). The decline in credit supply started after China's entrance into the WTO and plateaued around 2005. Unfortunately, we cannot test for the long-term effects of exposure on credit because the global financial crisis hit banks in 2008.

C. Heterogeneous Effects across Firms

The China shock analyzed here is both a sectoral and, given its magnitude, macroeconomic shock. As predicted by a classic Heckscher-Ohlin or Ricardian framework, absent frictions in the reallocation of factors of production, firms not directly hit by the trade shock are expected to expand upon the liberalization episode. By analyzing the heterogeneous effect of bank credit supply across firms that are expected to expand and those most negatively hit expected to contract, we learn

TABLE 2—BASELINE RESULTS

Dep. variable:	$\ln C_{ibt}$		i_{ibt}	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)
$Exposure_{-i,b}^{IT} \times Post_t$	-0.068 (0.0046)	-0.074 (0.0062)	0.0059 (0.0004)	0.0052 (0.0006)
<i>First stage</i>				
$Exposure_{-i,b}^{OC} \times Post_t$		0.79 (0.01)		1.01 (0.02)
AR-Wald test, F		131.78		79.82
Bank controls	✓	✓	✓	✓
Firm-time FE	✓	✓	✓	✓
Firm-bank FE	✓	✓	✓	✓
Observations	3,499,092	3,499,092	2,291,698	2,291,698
Adj. R^2	0.832	0.832	0.632	0.632

Notes: The table reports the results of specification (5). In columns 1 and 2, the dependent variable is the log of outstanding credit between bank b and firm i in year t . In columns 3 and 4, it is log of interests and fees relative to outstanding credit, for bank b and firm i in year t . $Exposure_{-i,b}^{IT}$, defined in equation (2), is instrumented with equation (4). Bank controls include bank characteristics pre-2000 interacted with a post-2001 dummy. These are log assets, share of NPLs, core-funding ratio, the capital ratio, and a firm-bank dummy that captures whether a firm operates in a sector of bank specialization. Standard errors are clustered at the bank-sector level.

about whether exposed banks rebalanced their supply of credit away from sectors most hit by the trade shock.

To this end, we expand equation (5) with an interaction indicator dummy D_g for firms belonging to different economic sectors: high-hit and low-hit manufacturing (defined relative to the median exposure to competition from China in equation (1)) and services^{21, 22}:

$$\begin{aligned}
 (6) \quad \ln C_{ibt} = & \sum_g \beta_g D_g \times Exposure_{-i,b}^{IT} \times Post_t + \beta_2 Spec_{ibt} \times Post_t \\
 & + \mathbf{X}_b' \boldsymbol{\delta} \times Post_t + \alpha_{it} + \gamma_{ib} + \epsilon_{ibt}.
 \end{aligned}$$

The results are reported in Table 3. We find the effect of bank exposure on the supply of credit is negative across the different types of firms. The point estimates are not statistically different. We also divide firms by the quartile of their sectoral exposure to import competition (rather than using a median cutoff) and find the coefficients are not statistically different across quartiles.²³

²¹Services include wholesale and retails trade, transportation and storage, accommodation and food service activities, information and communication, and professional, scientific, and technical services. All service sectors are considered not directly affected by import competition from China.

²²The results hold also if we define *Low-Hit* firms as those in the bottom quartile of exposure among manufacturing sectors.

²³See Table A.7 in the Supplemental Appendix.

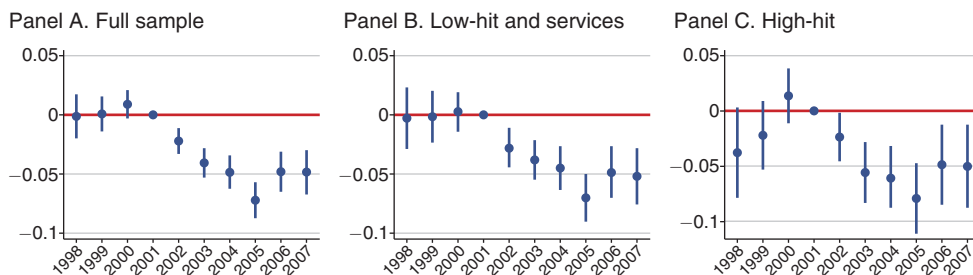


FIGURE 5. DYNAMIC DIFFERENCE-IN-DIFFERENCES (95 percent CI)

Notes: The figure reports the coefficients, with 95 percent confidence interval, of the variable $Exposure_{i,b}^{IT}$, instrumented with the variable $Exposure_{i,b}^{OC}$, coming from the dynamic difference-in-differences version of specification (5) in panel A and from specification (6) in panels B and C.

Overall, we find exposed banks reduced the supply of credit by a similar magnitude across different groups of firms. More exposed banks did not prioritize expanding sectors when allocating their funds; rather, they also transmitted the negative effect of the lending channel to such sectors. This result is robust to alternative definitions of potential winners from the China shock, such as firms in *Low-Hit* sectors where Italy has a comparative advantage to export or firms that are highly productive (see Section VA).

D. Effect on the Number of Bank-Firm Relationships

Our baseline specification in equation (5) estimates the effect of bank exposure to the trade shock on the *intensive* margin of credit, using bank-firm credit relations that exist before and after China's entrance into the WTO. In other words, this specification captures the supply-driven rebalancing of the firm's credit across those banks that were already lending to the firm before 2001. But the contraction in credit supply may also trigger less exposed banks to substitute for more exposed banks.

We explore the *extensive* margin of credit, that is, the impact of bank exposure on the probability of closing or opening lending relationships. We run the following specification looking at the firm-bank relationships in the *Pre* and *Post* periods (1998–2001 versus 2002–2007):

$$(7) \quad Exit_{ib\tau}(Entry_{ib\tau}) = \beta_1 Exposure_{(-i),b}^{IT} \times Post_{\tau} + \beta_2 Spec_{ib\tau} \times Post_{\tau} \\ + \mathbf{X}'_b \boldsymbol{\delta} \times Post_{\tau} + \alpha_{i\tau} + \gamma_b + \epsilon_{ib\tau}.$$

In this two-period panel, τ refers to the years pre- and post-2002.

The specification on *Exit* is run over the set of firms that have a credit relation with bank b in period τ . The dependent variable takes the value of 1 if the credit relation ends during the corresponding period (i.e., $C_{ib,t} > 0$ for at least one year in (1998, 2000) and $C_{ib,2001} = 0$ when $\tau = Pre$, and $C_{ib,t} > 0$ for at least one year in (2002, 2006) and $C_{ib,2007} = 0$ when $\tau = Post$), and 0 otherwise.

TABLE 3—BASELINE RESULTS: HETEROGENEOUS EFFECTS

Dependent variable:	ln C_{ibt}	
	OLS (1)	2SLS (2)
$Exposure_{-i,b}^{IT} \times Post_t \times ManufHighHit_i$	−0.063 (0.0088)	−0.068 (0.0131)
$Exposure_{-i,b}^{IT} \times Post_t \times ManufLowHit_i$	−0.070 (0.0074)	−0.079 (0.0102)
$Exposure_{-i,b}^{IT} \times Post_t \times Services_i$	−0.069 (0.0062)	−0.072 (0.0084)
Bank controls	✓	✓
Firm-time fixed effects	✓	✓
Firm-bank fixed effects	✓	✓
Observations	3,499,092	3,499,092
Adj. R^2	0.832	0.832

Notes: The table reports the 2SLS results of specification (6). $Exposure_{-i,b}^{IT}$ defined in equation (2) is instrumented with equation (4). High-hit and low-hit firms are manufacturing sectors above and below median exposure defined in equation (1). Standard errors are double clustered at the bank-sector level.

The specification on *Entry* is run over all the potential firm-bank combinations, that is, taking all the banks in the province where the firm operates.²⁴ $Entry_{ib\tau}$ is equal to 1 if the relationship was created during the period τ (i.e., $C_{ib,98} = 0$ and $C_{ib,01} > 0$ when $\tau = Pre$, and $C_{ib,02} = 0$ and $C_{ib,07} > 0$ when $\tau = Post$), and 0 otherwise. Because this regression refers to new bank-credit relationships, the measure of exposure $Exposure_b^{IT}$ is not firm specific. By definition, this measure is not using information on firm i .

The specification accounts for whether the bank is specialized in the sector in which the firm operates, for bank fixed effects, for the bank's pre-characteristics interacted with the period dummy, and for firm-period fixed effects. Standard errors are clustered at the bank-sector level. The coefficient of interest β_1 captures the marginal effect of a bank's exposure to the trade shock on the probability that bank b ends (starts) a credit relation with firm i . High elasticity of both exit and entry margins may suggest the replacement of more exposed banks with less constrained ones.

We find that, as expected, more exposed banks are more likely to terminate credit relationships after 2002. In column 1 of Table 4, we show a 1 standard deviation increase in bank exposure is associated with a 4 percentage point increase in the probability of exit, out of an unconditional entry probability of 17.5 percent. The results are not significantly different for firms in high-hit and low-hit manufacturing sectors and services (column 2).

Contrary to our priors, exposed banks *are not* less likely to start new credit relationships after China's entry into the WTO (columns 3 and 4). The baseline probability of entry over the universe of potential banks is very low (1.0 percent). The effect of exposure on entry is positive, but its magnitude is not economically large: A

²⁴From a regulatory point of view, a province is the relevant administrative unit to determine market concentration in lending.

TABLE 4—FIRMS' ENTRY AND EXIT (2SLS)

Dependent variable:	$Exit_{ibt}(\times 100)$		$Entry_{ibt}(\times 100)$	
	(1)	(2)	(3)	(4)
$Exposure_{(-i),b}^{IT} \times Post_{\tau}$	3.96 (0.600)		0.025 (0.006)	
$Exposure_{(-i),b}^{IT} \times Post_{\tau} \times ManufHighHit_i$		3.18 (0.954)		0.088 (0.011)
$Exposure_{(-i),b}^{IT} \times Post_{\tau} \times ManufLowHit_i$		3.66 (0.851)		0.020 (0.010)
$Exposure_{(-i),b}^{IT} \times Post_{\tau} \times Services_i$		4.58 (0.730)		0.007 (0.007)
Bank controls	✓	✓	✓	✓
Firm-period fixed effects	✓	✓	✓	✓
Bank fixed effects	✓	✓	✓	✓
Observations	582,549	582,549	35,053,469	35,053,469
Adj. R^2	0.239	0.239	0.088	0.088

Notes: The table reports the results of the extensive margin specification in equation (7). The dependent variable is a dummy that takes the value of 1 if firm i ends (exit) or starts (entry) a credit relation with bank b in period τ ($\tau = 1998 - 2001, 2002 - 2007$). Results are expressed in percentage points. Baseline unconditional probability for *Exit* is 17.5 percent, and for *Entry* is 1.0 percent. $Exposure_{(-i),b}^{IT}$ is instrumented with (4), leaving firm i out in the case of exit. High-hit (low-hit) firms are manufacturing sectors with above- (below-) median exposure defined in equation (1). Bank controls include bank characteristics pre-2000 interacted with a post-2001 dummy. These are log assets, share of NPLs, core-funding ratio, the capital ratio, and a firm-bank dummy that captures if a firm operates in a sector of bank specialization. Standard errors are clustered at the bank-sector level.

1 standard deviation increase in bank exposure is associated with a 0.025 percentage point increase in the probability of entry.

Overall, more exposed banks reduced their number of credit relationships after 2002.²⁵ However, we do not find less exposed banks significantly increased their number of new clients (relative to other banks).

III. Transmission and Amplification of the Trade Shock

The previous section shows a significant negative effect of bank exposure to the China shock on its supply of credit. However, this result may not necessarily imply a negative effect on firms' overall credit availability. Firms could be rebalancing their sources of funding toward less exposed banks, ending up with no overall change in the firm-level amount of credit or real outcomes. Moreover, for banks' lending constraints to end up affecting firms' real outcomes, one needs to show that, first, overall firm availability of credit is reduced, relative to less affected firms, and second, that firms' real output is sensitive to changes in credit availability. This section addresses these goals.

²⁵This finding is consistent with evidence from data on loan applications in Table A.8 in the Supplemental Appendix. We find firms more exposed to the bank lending channel increase their number of applications to less exposed banks and decrease it to the more exposed ones, but we do not observe a change in the overall number of applications.

A. Lending Channel and Firm-Level Outcomes

To assess the overall impact of bank exposure to the China shock on the firm's availability of credit, we first compute, for each firm, the average exposure of related banks, weighted by its pre-2001 share of credit across banks:

$$(8) \quad \text{Firm Level Exposure}_i = \sum_b \text{Exposure}_{-i,b}^{IT} \frac{\text{Credit}_{ib}}{\text{Total Credit}_i},$$

where $\text{Exposure}_{-i,b}^{IT}$ is the bank exposure to the shock (leaving out firm i), defined in (2).

Using this firm-level exposure as the main independent variable, we run the following regression at the firm-year level:

$$(9) \quad \ln Y_{it} = \beta_1 \text{Firm Level Exposure}_i \times \text{Post}_t + \mathbf{X}_i' \boldsymbol{\delta} \times \text{Post}_t + \gamma_i + \delta_{st} + \epsilon_{ist},$$

where Y_{it} refers to the firm-level dependent variable of firm i in year t , which is regressed on the interaction between firm-level exposure and the post-2001 dummy, firm fixed effects γ_i , and sector-time fixed effects δ_{st} . $\text{Exposure}_{-i,b}^{IT}$ is instrumented, as usual, using $\text{Exposure}_{-i,b}^{OC}$ in equation (4). $\mathbf{X}_i$ is a vector of pre-shock lender characteristics (weighted by the firm's share of credit) parallel to $\mathbf{X}_b$ in equation (5).²⁶

We start by analyzing the overall supply of credit to the firm (i.e., $Y_{it} = C_{it}$). We interpret the coefficient β_1 in equation (9) as the effect in overall firm-level credit supply, under the assumption that, conditional on sector-time fixed effects and on the average characteristics of firms' lenders, firm-level demand for credit is uncorrelated with the exposure of its related banks to the shock. Column 1 in Table 5 shows the negative coefficient on firm level exposure is confirmed.²⁷ The negative coefficient on firm-level exposure is confirmed: a 10 percent increase in firm-level exposure results in around 6 percent reduction in the supply of credit. Column 2 shows the 2SLS results of equation (9) for different groups of firms: high-hit and low-hit manufacturing sectors, and services. A 10 percent increase in firm-level exposure results in a 5 percent and 7 percent reduction of credit for firms in services and *Low-Hit* manufacturing, respectively. The effect increases to 9 percent for firms in sectors most directly hit by import competition from China.

Next, we analyze how firms' share of exposed credit affects real outcomes.²⁸ Columns 3 to 8 report the marginal effects on employment, investment, and revenues, controlling for firm and sector-time fixed effects.²⁹ These results reflect the combination of firms' availability of credit and the elasticity of the corresponding real outcome to funding. Columns 3, 5, and 7 show the estimates for the full sample

²⁶In Supplemental Appendix A.12, we show the results of specification (9), which includes, as an additional control, the firm-time fixed effects ($\hat{\alpha}_{it}$) estimated in equation (5), as in Cingano, Manaresi, and Sette (2016); Bofondi, Carpinelli, and Sette (2018); and Alfaro, García-Santana, and Moral-Benito (2021).

²⁷Table A.14 in the Supplemental Appendix reports the results of an alternative specification, based on a first difference between pre- and post-periods.

²⁸Results are robust to using a first-difference specification. See Table A.14 in the Supplemental Appendix.

²⁹Sector-time fixed effects absorb the direct effect of import competition from China on firms' real outcomes. A caveat is that these controls are based on firms' main sector of activity; therefore, they might not be complete for firms whose activities span multiple sectors that were differentially affected by the China shock.

TABLE 5—EFFECT ON FIRMS' OUTCOMES (2SLS)

	ln C_{it}		ln Emp_{it}		ln Inv_{it}		ln Rev_{it}	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$FirmExp_i \times Post_t$	-0.0622 (0.0160)		-0.0475 (0.0136)		-0.0651 (0.0187)		-0.0668 (0.0140)	
$FirmExp_i \times Post_t$ $\times HighHit_i$		-0.0850 (0.0212)		-0.0979 (0.0179)		-0.113 (0.0240)		-0.117 (0.0188)
$FirmExp_i \times Post_t$ $\times LowHit_i$		-0.0705 (0.0189)		-0.0564 (0.0157)		-0.0561 (0.0221)		-0.0514 (0.0172)
$FirmExp_i \times Post_t$ $\times Services_i$		-0.0485 (0.0171)		-0.0254 (0.0146)		-0.0486 (0.0201)		-0.0530 (0.0146)
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Sector-time FE	✓	✓	✓	✓	✓	✓	✓	✓
Bank controls	✓	✓	✓	✓	✓	✓	✓	✓
Observations	793,968	793,968	793,968	793,968	793,968	793,968	793,968	793,968
Adj. R^2	0.896	0.896	0.919	0.919	0.919	0.919	0.914	0.914

Notes: The table reports the coefficients of the specification in equation (9). The dependent variable is the log of total outstanding credit of firm i in year t in columns 1–2, log of employment in columns 3–4, log of investment in columns 5–6, and log of revenues in columns 7–8. $FirmExp_i$ is defined in equation (8). Bank controls are vector of weighted average lender characteristics pre-2000 (log assets, share of NPLs, core-funding ratio, and the capital ratio). Standard errors are clustered at the sector-main-bank level.

of firms. For the average firm, we find a 10 percent higher dependence on exposed banks is associated with a 4 percent to 6 percent drop in their real outcomes, relative to other firms in the same sector. Columns 4, 6, and 8 show the heterogeneous effect across firms differently hit by import competition. Among firms in manufacturing sectors directly competing with Chinese imports (high-hit group), these effects are significantly larger: The impact on employment is 10 percent, and, for investment and revenue, these figures increase to 11 percent and 12 percent, respectively.³⁰

B. Economic Relevance

According to the results above, the sensitivity of real outcomes to credit restrictions by exposed banks is substantially higher for manufacturing firms in high-hit sectors. Moreover, by definition, firms in high-hit sectors are, on average, more dependent on those banks. They were therefore more likely to suffer from credit rationing. To account for these two factors, we follow Chodorow-Reich (2014) and compute what they call *partial equilibrium aggregation*. Without accounting for general equilibrium responses, this measure adds the direct impact of the lending channel on real outcomes, taking into account the joint distribution of firms' exposure to the financial shock and their sensitivity to credit. The full detail of the computations is in Supplemental Appendix A.2.

Our results in Table 5 are estimated including sector-time fixed effects and a vector of pre-shock lending characteristics. They therefore compare the change in

³⁰Table A.10 in the Supplemental Appendix confirms the negative effects on employment, investment, and revenues also for low-hit firms that are highly productive and for those in sectors with a comparative advantage or that are downstream to the China shock and could benefit from cheaper inputs.

TABLE 6—AGGREGATE EFFECTS OF THE BANK-LENDING CHANNEL

	Employment		Credit	
	Growth (1)	Abs. variation (2)	Growth (3)	Abs. variation (bn.) (4)
High-hit manuf.	−2.9%	−79,350	−2.6%	−1.0
Low-hit manuf.	−1.4%	−31,800	−1.8%	−2.0
Services	−1.3%	−60,151	−1.7%	−3.0

Note: The table reports the results of the partial equilibrium aggregation exercise discussed in Section IIIB and in Supplemental Appendix A.2.

credit supply by firms differently exposed to the lending channel (i.e., the slope) but do not inform on its level (i.e., the intercept). Given this limitation, to perform this aggregation exercise, we assume firms in the bottom 10 percent of the distribution of exposure are unconstrained in their access to credit (at a constant interest rate).³¹ Then, for each firm, we compute the difference in employment (credit) if it had a level of exposure equal to the “unconstrained” threshold. As an example, consider a firm in the seventy-fifth percentile of the exposure distribution. We take the difference in firm-level exposure with respect to a firm in the tenth percentile and multiply it by the coefficient -0.0295 estimated in Table 5, getting a relative employment differential of -0.95 percent. We apply the same logic to the entire distribution of firms (using the regression coefficients by group) and weight each firm according to its share of employment (respectively, credit). In doing so, we are adding the direct effect of the lending channel, without allowing for general equilibrium effects.

Table 6 shows the results of this aggregation exercise for employment (columns 1 and 2) by group of firms. We find the growth rate of employment for high-hit firms after China’s entrance into the WTO could have been 2.9 percent higher if the bank lending channel were not binding. Given that employment in high-hit sectors declined by 335,000 workers in those years, the amplification effect of the lending channel is around 80,000 missing workers, almost one-fourth of the overall job losses in these sectors. For low-hit manufacturing sectors, the effect was -1.4 percent on growth, which translates into about 32,000 forgone jobs (in those years 112,000 jobs were created in those sectors). Finally, for services, we find a negative effect of -1.3 percent, which implies this sector employed 60,000 fewer workers than it could have otherwise (employment in services grew by 865,000 units).³² Columns 3 and 4 show the results for credit. Notice our quantification exercise is based on a counterfactual scenario without the financial shock. This scenario is not meant to capture a counterfactual without the China shock. It captures the effect of the China shock absent the endogenous contraction in credit supply. In other words, it isolates the role of the lending channel: how banks amplified the original shock

³¹ Figure A.3 in the Supplemental Appendix shows the share of credit and employment by deciles of firms’ exposure. Firms in the bottom decile of the distribution account for 6 percent of total credit and employment, whereas firms in the top quartile of the distribution account for 42 percent of total employment and 40 percent of credit.

³² The rise of employment in services is in line with the structural trend shown in Figure 1, panel B, and it occurs in a period when the labor force increased by almost 1 million.

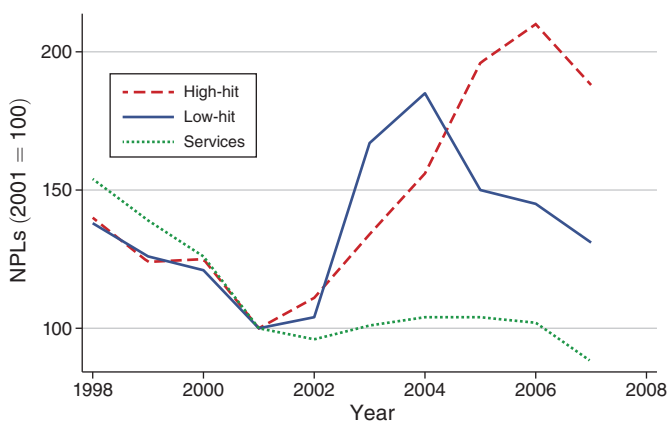


FIGURE 6. THE UNDERLYING MECHANISM: THE ROLE OF NPLS

Notes: The figure reports the evolution of the total amount of NPLs by group of firms. The value of NPLs is normalized to 100 in 2001.

to firms already hit by import competition and how they transmitted it to expanding sectors.

IV. The Underlying Mechanism: Banks' NPLs

In this section, we investigate the mechanism that links the trade shock that firms face with the patterns of credit allocation by related banks.

We start by looking at the evolution of the value of NPLs for firms in high-hit and low-hit sectors, and services (Figure 6). After having a similar declining trend up to 2001, they start to diverge. The stock of NPLs of high-hit firms starts to increase after 2001 and almost doubles by the end of our period of analysis, moving from €3.4 billion to €6 billion between 2002 and 2007 (equivalent to an increase from 10 percent to 20 percent of the share of nonfinancial corporations' NPLs). This increase was large relative to banks' capital, which was €56 billion for the whole system at the onset of the shock. The increase of NPLs of low-hit firms is lower; starting from €3.4 billion, it spikes in 2003 coincidentally with the GDP slowdown of Italy and falls subsequently to €4.2 billion, whereas NPLs of firms in services remain stable after 2001.

More formally, we estimate the following linear probability model at the bank-firm-period level:

$$(10) \quad NPL_{ib\tau} = \alpha_{ib} + \alpha_{b\tau} + \beta China_{is}^{IT} \times Post_{\tau} + \epsilon_{ib\tau}$$

where $NPL_{ib\tau}$ is a dummy equal to 1 if the firm-bank loan is nonperforming and the independent variable $China_{is}^{IT}$ corresponds to the exposure of firm i 's sector to imports from China, as defined in (1), instrumented with (3). The specification includes a full set of firm-bank fixed effects and bank-period fixed effects. These controls are meant to capture time-invariant characteristics of the firm and bank and also the potential reversed effect of bank-wide changes in credit supply on the

TABLE 7—FIRM EXPOSURE AND NPL

Dep. var: NPL_{ibt}	OLS (1)	2SLS (2)
$China_{is}^{IT} \times Post_{\tau}$	0.00625 (0.00158)	0.00904 (0.00242)
Firm-bank fixed effects	✓	✓
Bank-period fixed effects	✓	✓
Observations	671,376	671,376
Adjusted R^2	0.560	0.560

Notes: Results on specification (10). Explanatory variable $China_{is}^{IT}$ defined in equation (1), instrumented with (3). Standard errors double clustered at the firm and bank level.

performance of related firms. The results in Table 7 confirm import competition from China increased the probability of the firm defaulting: A 1 standard deviation increase in the former is associated with a rise in the latter by almost 1 percentage point, whereas the unconditional probability of default is 4 percent.

Next, we exploit detailed information on banks' balance sheet. To more formally test the link between bank exposure, NPLs, and lending capacity, we run the following specification:

$$(11) \quad Y_{bt} = \beta_1 Exposure_b^{IT} \times Post_t + \mathbf{X}'_b \boldsymbol{\delta} \times Post_t + \gamma_b + \alpha_t + \epsilon_{bt}.$$

$Exposure_b^{IT}$ is the non-leave-out version of our measure of bank exposure as defined in equation (2), which as usual, is instrumented with equation (4). We also control for a vector of bank pre-2000 characteristics interacted with a dummy for the years after China's entrance into the WTO, bank fixed effects, and time dummies. We cluster the standard errors at the bank level. The dependent variable Y_{bt} corresponds to the components of the bank's balance sheet. In particular, column 1 in Table 8 shows the results with $Y_{bt} = NPLsRatio_{bt}$, the share of NPLs on total assets in banks' balance sheets. We confirm the evidence from Figure 6: A 1 standard deviation higher bank exposure to the trade shock is associated with a 0.3 percentage point increase in the NPL ratio after China's entrance into the WTO. This effect is sizable given that the NPL ratio for the median bank in those years is 1.4 percent (the mean is 1.9 percent).

We find evidence that more exposed banks suffer from an erosion of their tier 1 capital, namely, core capital relative to risk-weighted assets (column 2), which is consistent with the increase in NPLs. We also observe an increase in bank provisions (column 3), which suggests more exposed banks set aside additional funds to cover for potential losses on loans.³³

We also explore whether more exposed banks suffer from funding issues such as (i) a reduction in deposits (column 4) because affected firms and households in depressed regions could have suffered from a fall in liquidity, (ii) a decrease in

³³The dynamic difference-in-differences in the Supplemental Appendix shows no increase in provisions before China's entrance into the WTO, suggesting banks did not anticipate the shock.

TABLE 8—BANK EXPOSURE AND BALANCE SHEET EFFECTS (2SLS)

	NPL (1)	Tier 1 (2)	Loan provisions (3)	Deposits (4)	Interbank (5)	Funding cost (6)	ROA (7)
$Exposure_b^{IT} \times Post_t$	0.003 (0.0007)	-0.002 (0.0006)	0.001 (0.0005)	0.000 (0.0018)	0.001 (0.003)	0.000 (0.0001)	0.000 (0.0001)
Bank controls	✓	✓	✓	✓	✓	✓	✓
Bank fixed effects	✓	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓	✓
Observations	4,890	4,890	4,890	4,890	4,890	4,890	4,890
Adj. R^2	0.714	0.851	0.821	0.943	0.827	0.844	0.583

Note: The table reports the results of specification (11) with the following dependent variables: NPL ratio, tier 1 capital (capital relative to risk-weighted assets), provisions on firms' loans that are not NPL relative to assets, deposits, net interbank borrowing, funding cost, and return on assets. Variables are expressed as a share of bank overall liabilities if not otherwise specified. $Exposure_b^{IT}$ is defined in equation (2) instrumented with (4). All regressions include bank controls interacted with a post-2001 dummy (i.e., pre-2000 log assets, core-funding ratio, NPL and the capital ratios). In each regression, we exclude the control that overlaps with the dependent variable. Standard errors are clustered at the bank level.

interbank lending (column 5), and (iii) higher funding costs (column 6). However, we do not find any significant difference along these dimensions. Finally, we do not find an effect on overall bank profitability (column 7).

Our results show NPLs increased for firms in sectors directly hit by import competition from China. Banks with a larger share of their loan portfolios in those affected sectors could not offset these losses with external capital and thus reduced their commercial lending. This finding is consistent with the predictions of classical banking models, such as Froot, Scharfstein, and Stein (1993); Holmström and Tirole (1997); and Froot and Stein (1998). Note this transmission mechanism is not symmetric for positive or negative real shocks. The corporate debt contract may become nonperforming when the firm goes through bad times, but its return does not follow a positive unexpected performance. This mechanism is different from the one at play in Bustos, Garber, and Ponticelli (2020), who found deposits respond to firms' positive productivity shocks.

As further support for this conclusion, we compare credit supply by banks with heterogeneous capital ratios at the onset of the trade shock. Table 9 reports the results of our baseline specification in equation (5) interacted with the tier 1 capital ratio before the shock (taking the 1998–1999 average). This effect of the bank's balance sheet shock on credit supply diminishes with the ex ante level of bank capitalization, which we interpret as a (inverse) measure of tightness of their lending capacity. This effect is statistically and economically significant for firms in low-hit sectors and services but not for high-hit firms, suggesting less constrained banks, equally affected by the trade shock, tilted the composition of their portfolio away from high-hit firms. Extrapolating the estimated coefficients, the predicted effect of the trade shock on credit supply to firms in low-hit sectors and in services is 0 for banks with capital ratios above 14 percent (they accounted approximately for 5 percent of total credit prior to the shock). This result is consistent with banks' motive for holding buffer capital in Repullo and Suarez (2013): It enables exposed banks to respond to lending opportunities in expanding sectors, despite the increase

TABLE 9—BASELINE RESULTS: INTERACTION WITH TIER 1

Dep. variable: $\ln C_{ibt}$	Full sample (1)	Manuf. low-hit	Manuf. high-hit (2)	Services
$Exposure_{-i,b}^{IT} \times Post_t$	−0.112 (0.0146)	−0.138 (0.0249)	−0.0516 (0.0203)	−0.127 (0.0170)
$Exposure_{-i,b}^{IT} \times Tier 1_b \times Post_t$	0.474 (0.152)	0.758 (0.223)	−0.256 (0.242)	0.727 (0.182)
$Tier 1_b \times Post_t$	0.701 (0.127)		0.763 (0.128)	
Bank controls	✓		✓	
Firm-bank fixed effects	✓		✓	
Firm-time fixed effects	✓		✓	
Observations	3,497,635		3,497,635	
Adj. R^2	0.832		0.832	

Notes: The table reports results of specification (5) in column 1 and those of specification (6) in column 2. Relative to the baseline specification, we add an interaction term $Tier 1_b$ (i.e., the ratio of core capital to risk-weighted assets for 1998–1999). $Exposure_{-i,b}^{IT}$ is instrumented with (4). All regressions include the rest of the corresponding interaction terms, bank controls interacted with a post-2001 dummy (i.e., pre-2000 log assets, share of NPLs, core-funding ratio, the capital ratio, and firm-bank specialization dummies). Standard errors are clustered at the bank-sector level.

in NPLs. Needless to say, because holding capital buffers is itself an endogenous decision of the bank, banks that chose to have extra capital could be those that are better at identifying lending opportunities; both factors would be confounded in the heterogeneous effect of banks' exposure on credit supply.

V. Robustness and Additional Results

In this section, we address several potential alternative mechanisms and identification challenges. Specifically, we analyze the heterogeneous effects of bank exposure across alternative definitions of potential winners and explore the robustness of our results by expanding the definition of “exposed” sectors and banks to account for input-output linkages. We also study the geographical dimension of the lending channel.

Additionally, we report in the Supplemental Appendix an extensive set of robustness checks with alternative measures of banks' and firms' exposure and with different econometric specifications. We show our main results are unchanged when (i) using a different set of countries to define the instrument of imports from China; (ii) measuring bank exposure leaving out credit to the sector where the firm operates; (iii) measuring bank exposure relative to banks' total assets rather than banks' corporate loans; (iv) leaving out the main sectors in which Italy exports to China; (v) including alternative sets of controls and fixed effects; (vi) estimating a weighted least-squares specification with observations weighted by firm size; (vii) estimating a first-difference transformation of the baseline specification; (viii) allowing for alternative clustering of the standard errors; (ix) looking at the heterogeneous effects across groups of firms using a quartile division rather than a

median cutoff for high-hit and low-hit sectors, as well as for productivity and comparative advantage.³⁴

A. Additional Dimensions of Firms' Heterogeneity

We expand the analysis in Section IIC by contemplating additional dimensions of firms' heterogeneity. Within low-hit manufacturing sectors, we also explore different ways that some firms may have benefited from China's entry into the WTO: first, those firms in sectors in which Italy has a comparative advantage,³⁵ second, the most productive firms in sectors not directly competing with imports from China.³⁶ Figure A.1 in the Supplemental Appendix shows the relative performance of these groups of firms in terms of exports or employment. We find that indeed the aggregate trend of these potential winners performs better after China's entrance in the WTO relative to the other firms in the economy. Table A.9 in the Supplemental Appendix shows the effect of the bank exposure on credit supply, estimated using the within-firm specification in equation (6). The results are not significantly different from our baseline estimates. Along the same lines, Supplemental Appendix Table A.10 shows the heterogeneous performance of these groups of firms in terms of employment, investment, and revenues, using the firm-level specification in equation (9). The results confirm the ones presented in Section IIIA.

B. Taking into Account Input-Output Linkages

Our baseline identification of sectors affected by competition from China in equations (1) and (3) considers only the direct exposure of a given industry to imports from China and therefore ignores the effects to downstream and upstream sectors. Table A.9 (column 3) in the Supplemental Appendix shows the heterogeneous effect of the trade shock on credit supply in equation (6) for firms in downstream *Low-Hit* sectors. Banks more exposed to the shock also reduce lending to these firms, which presumably benefited from cheaper inputs from China, relative to less exposed banks lending to the same firm. The corresponding effect on firm-level employment, investment, and revenues is shown in Table A.10 in the Supplemental Appendix.³⁷

We also modify our measure of sectoral exposure to the liberalization shock by incorporating the indirect effect, through input-output linkages, on the demand for inputs used by sectors directly competing with China. Following Acemoglu et al. (2016), we calculate for each industry j the weighted average change in Chinese imports across all industries that purchase from industry j . The weights are the shares

³⁴ We also explored heterogeneous effects by firm size and the Rajan-Zingales measure of financial dependence (available upon request). The effects do not vary with these dimensions of heterogeneity.

³⁵ Using COMTRADE, we compute a standard Balassa index of revealed comparative advantage for each manufacturing three-digit sector for 1994–1998. World exports correspond to the sum of exports from 89 countries (i.e., countries for which Comtrade data are available in each year of the reference period).

³⁶ We compute total factor productivity at the firm level (TFPR) following Levinsohn and Petrin (2003) and Wooldridge (2009). We take the firm average and the sector-weighted average TFPR for the period 1998–1999, and we define high- versus low-productivity firms according to whether they are above or below their sectoral average.

³⁷ We compute a weighted average of downstream exposure to high-hit sectors, using the input-output table for Italy, which is available only at the two-digit level, and select sectors above the median value; that is, our group of interest is given by firms in low-hit sectors with a share of input from high-hit firms above the median.

of industry j 's total sales that are used as inputs in each industry according to the 1995 input-output table, which predates China's entry into the WTO. One limitation is that for Italy, this information is available at the two-digit industry only (ISTAT 1995). Therefore, we assume that for a given four-digit industry, its input and output shares are proportional to the corresponding shares of its two-digit industry. We then compute the sum of our baseline measure of bank exposure and of the measure that takes into account the upstream effects on the borrowing industries.³⁸ Columns (7) and (8) of Table A.2 in the Supplemental Appendix confirm the baseline results.

C. The Geographical Dimension of the Bank Lending Channel

In this subsection, we investigate the geographical dimension of bank lending. Some economic activities may be geographically clustered. Then, the China shock may disproportionately affect some regions and their local labor market or nontradable sector. We therefore analyze whether bank lending differs across regions.

Using information on the location and size of firms, we compute the employment-weighted average of its sectors' exposure to the China shock as defined in equation (3).³⁹ We look at our results across provinces with different sectoral compositions.⁴⁰ Table 10 reports the baseline results from equations (5) and (6), dividing our sample between firms located in provinces above and below the median share of employment in high-hit sectors. The effect of bank exposure on credit supply is negative and significant in all cases. More exposed banks reduced their share of credit, for the same firms, in all provinces in which they operate. The effect of bank exposure is only slightly larger in provinces with above-median concentration in exposed sectors. In other words, more constrained banks reduced their share of credit, especially in already depressed provinces, but they do so also in areas less affected by the shock and for firms with low exposure to import competition.

In Table A.13 in the Supplemental Appendix, we show our conclusions in Section IIIA are robust to absorbing sector-province-time fixed effects. Overall, we conclude the lending channel analyzed here operates beyond other potential mechanisms arising from local general equilibrium effects.

VI. Concluding Remarks

This study shows that, in the aftermath of a trade-liberalization episode, banks can amplify the shock to firms hit by import competition from China and propagate it to firms in sectors expected to expand upon liberalization. Focusing on China's entry into the WTO, we find banks with a portfolio of loans concentrated in sectors exposed to competition from China decrease their lending relative to less exposed banks. As import competition from China leads to higher NPLs among competing firms, the balance sheet of exposed banks suffers losses that lead to an

³⁸The correlation between the baseline measure of bank exposure and the new one is 0.96.

³⁹Italy has 108 provinces, which are administrative units of the intermediate level between a municipality and a region, comparable to US counties. The average bank typically operates across 15 provinces.

⁴⁰In the Supplemental Appendix, we also show how the results change with other dimensions of regional heterogeneity: innovation, education, and industrial diversification (Table A.11 in the Supplemental Appendix).

TABLE 10—GEOGRAPHICAL EFFECTS BY PROVINCE EXPOSURE (2SLS)

Dependent variable: $\ln C_{ibt}$	High-exposure provinces		Low-exposure provinces	
	(1)	(2)	(3)	(4)
$Exposure_{-i,b}^{IT} \times Post_t$	−0.0827 (0.00786)		−0.0585 (0.00934)	
$Exposure_{-i,b}^{IT} \times Post_t \times ManufHighHit_i$		−0.0775 (0.0166)		−0.0480 (0.0186)
$Exposure_{-i,b}^{IT} \times Post_t \times ManufLowHit_i$		−0.0784 (0.0138)		−0.0825 (0.0144)
$Exposure_{-i,b}^{IT} \times Post_t \times Services_i$		−0.0881 (0.0107)		−0.0471 (0.0127)
Bank controls	✓	✓	✓	✓
Firm-time fixed effects	✓	✓	✓	✓
Firm-bank fixed effects	✓	✓	✓	✓
Observations	2,118,046	2,118,046	1,378,456	1,378,456
Adj. R^2	0.835	0.835	0.828	0.828

Notes: The table reports results of specification (5) in columns 1 and 3 and specification (6) in columns 2 and 4. We group firms according to the exposure of their province to the China shock. High- (low-) exposure provinces correspond to those with a share of employment in high-hit sectors above (below) the median. The dependent variable is the log of outstanding credit between bank b and firm i in year t , $\ln C_{ibt}$. The variable $Exposure_{-i,b}^{IT}$ is instrumented with (4). Other bank controls include bank characteristics pre-2000 interacted with a post-2001 dummy. These are log assets, share of NPLs, core-funding ratio, the capital ratio, and a firm-bank dummy that captures whether a firm operates in a sector of bank specialization. Standard errors are clustered at the bank-sector level.

erosion of their core capital. Consequently, these banks reduce their credit supply to all their related firms, irrespective of their industry of operation. Firms borrowing from exposed banks cannot perfectly substitute constrained sources of funding; their overall availability of credit is therefore reduced. We also find this financial tightening, which endogenously arises in the aftermath of the liberalization episode, has significant effects on employment, investment, and overall revenues.

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