How do banks propagate economic shocks? *

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Abstract

This paper exploits the COVID-19 pandemic as a negative shock on firm revenues and studies the transmission of this shock across industries via banks. We use the ex-ante heterogeneity in the amount of loans issued to affected industries to measure the variation in banks' exposure to the negative shock. Using bank-firm level credit register data from Turkey, we show that banks transmitted the shock by decreasing their loan supply not only to affected but also to unaffected industries. The effect persists at the firm level, yet lower for large firms and for firms with an existing relationship to state-owned banks.

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1 Introduction

The COVID-19 pandemic resulted in a dramatic drop in revenues of many firms. The shock led to an environment where firms in some industries were not able to sell their products or services as a result of the subsequent lockdowns. This paper studies the transmission of this negative shock across industries via banks. COVID-19 provides a unique opportunity to shed light on the propagation of negative shocks across industries for two reasons. First, it was an exogenous shock that serves as a natural experiment to provide a clean identification setting (see, e.g., Eldar and Wittry, 2021; Ramelli and Wagner, 2020; Fahlenbrach et al., 2021). Second, the pandemic led to heterogenous effects on firm revenues in different industries. The firms operating in industries hit most by the COVID-19 pandemic, such as brick-and-mortar retailers, suffered large negative shocks to their revenues. On the other hand, firms operating in the food processing industry or the pharmaceutical products industry did not suffer from revenue losses during the pandemic. This large variation in the impact of the pandemic on industry revenues makes COVID-19 a unique setting to study the transmission of negative shocks across industries via banks.

In this paper, we use this setting to investigate how banks transmit negative economic shocks from hardest hit industries to unaffected industries through the bank lending channel. We proceed in two steps. We first calculate the negative economic shock at the industry level. For tradable sectors, we use the decline in revenues. For non-tradable sectors, we use the credit card spending at the province level in a given industry as a proxy for revenues and calculate the drop in the credit card spending. According to our measure, the larger the fall in the revenues in an industry the bigger the negative shock to that industry. Second, we measure each bank's exposure to this negative shock by calculating a loan-weighted shock of each industry in the bank's pre-pandemic loan portfolio, i.e., a loan-weighted percentage fall in industry revenues, where the weights are the pre-pandemic loan portfolio shares in each industry. We focus on short-term loans since the losses on short-term loans are realized

sooner.[1] According to our measure, banks that had more short-term loans issued to industries with a larger negative shock were more exposed to the shock since their borrowers struggled to pay back their loans and, as a result, they either experienced loan losses or had anticipations of loan losses in the short future.[2]

When we calculate banks' exposure to the industries with the negative revenue shock, it is important to use the pre-pandemic short-term loan portfolios of banks calculated at the end of 2019 to make sure that banks did not know about the coming pandemic when they issued these loans. As a result, when the pandemic hit the revenues in these industries, it was a shock for the banks that had large amounts of outstanding short-term loans to firms in these industries. This makes the COVID-19 pandemic a valuable opportunity to gain insights into the transmission of this negative shock from affected industries to unaffected industries via banks.

To provide compelling evidence on the transmission of this shock, we need to disentangle the supply side effect from the demand side effect. To achieve this, we exploit credit register data provided by the Central Bank of the Republic of Turkey that contain comprehensive monthly bank-firm level loan data. We use a difference-in-differences approach to compare lending before and after the COVID-19 pandemic among banks with different exposure to the negative shock. The granularity of the credit register data enables us to saturate identifications with firm $\times$ year-month fixed effects to account for all time-varying observed and unobserved firm characteristics that might be correlated with changes in loan demand. By including firm $\times$ year-month fixed effects, we focus on firms that borrow from multiple banks with different exposure to the COVID-19 shock. We study whether the same firm experienced a decrease in the amount of loans issued by a bank with higher exposure relative to another bank with lower exposure. In addition, we control for firm $\times$ bank fixed effects to absorb any time-invariant unobserved characteristics for firm-bank pairs that might capture

[1] Short-term loans are loans with maturities less than one year.

[2] We further provide robustness tests in the Internet Appendix where we calculate a similar exposure measure using the total amount of outstanding loans regardless of the maturity.

the relationship lending between them.

We show evidence for the following robust results: We find that banks that had larger exposure to the negative shock supplied significantly less loans during the COVID-19 pandemic. A 1 percentage point increase in the exposure of a bank led to a 6.64 percent reduction in the amount lent by that bank, which is statistically significant and economically relevant: A 1 standard deviation increase in banks' exposure to the shock resulted in a loan reduction by almost 8 percent. This reduction happens for both short- and long-term loans: Banks with a 1 percentage point higher exposure decreased the supply of their short-term loans by 7.82 percent and their long-term loans by 9.36 percent. When we study the change in loans for each month separately, we find that the shock led to a significant reduction in loans in each month from April to September, 2020. In addition, the monthly results reveal that the reduction gets larger over time. This implies that the effect of the shock on banks' loan supply increases gradually.

The next interesting question is whether banks with high exposure to the shock decreased their loans to firms operating in unaffected industries as well, i.e., whether the negative shock is transmitted from affected industries to unaffected industries via banks. When we divide our sample into more- and less-affected industries, we find that exposed banks reduced their loan supply significantly to firms operating in less-affected industries (6.9 percent) as well as more-affected industries (6.44 percent), where the magnitude of the reduction is similar. This result implies that banks transmit the negative economic shock originated in one industry to another industry by reducing their loan supply to the firms operating in the other industry.

We next examine whether firms could avoid a reduction in their total loans by switching to less exposed banks. To examine this, we move to the firm level and analyze whether firms that borrowed more from high-exposure banks before the pandemic experienced a significant reduction in their total loans. It is important to note that we include industry $\times$ province $\times$ year-month fixed effects as well as firm fixed effects in our firm-level regressions. As a result, the coefficient estimates show changes in the amount of loans for firms with different

exposure that are operating in the same industry and located in the same province. This makes sure that the economic shock calculated at the industry level, that we use to measure each bank's exposure to the shock, cannot drive our results at the firm level. Instead, the results are driven by the shock that the firm experiences via its banks' exposure.

We show that firms with a 1 percentage point higher exposure experienced a significant drop in their total loans by 4 percent. Given that firms' average exposure to the negative shock was 0.025, this suggests that firms on average experienced an almost 10 percent reduction in their total loans. This finding indicates that firms could not entirely switch to other banks with less exposure to avoid a reduction in their total loans. In addition, we find that firms with higher exposure experienced a significant decrease in the number of banks that they borrow from. A 1 percentage point increase in a firm's exposure to the shock decreases the number of banks that it is borrowing from by 1.8 percent. Consistent with this, we show that firms that have higher exposure decreased the share of their loans in highly exposed banks and switched to less exposed banks. We then demonstrate that firms with high-exposure banks experienced a decline in their sales during Q2 and Q3 of 2020 as a result of the reduction in their total loans.

During the pandemic, the Turkish government provided liquidity to the real economy via state-owned banks where state-owned banks issued large amounts of loans to firms. The next interesting question is whether firms were able to reduce the effect of the shock by getting loans from state-owned banks.[3] When we study the changes in the fraction of loans issued by state-owned banks, we find that firms, on average, experienced a significant increase in the amount of loans from state-owned banks by 0.16 percent. When we divide our sample into two as the firms that had an existing relationship with a state-owned bank and the ones that did not, we show that the significant increase in the state-owned bank loans comes from the former group whereas the latter group had a reduction in their loans from state-owned

[3]In our main analysis, when we establish the transmission of the negative shock, we focus on privately-owned banks since state-owned banks have less binding financial constraints and, as a result, the negative shock is not expected to have an impact on their loan supply.

banks. Consistent with this, we find that the former group experienced a significantly less reduction in their loans (2.9 percent) relative to the latter group (5 percent). This suggests that the firms that had a pre-pandemic lending relationship with a state-owned bank could switch from privately-owned banks to state-owned banks to reduce the decline in their total loans. This implies that the provision of liquidity by the government through state-owned banks helped these firms to alleviate the impact of the negative shock significantly.

According to the literature, the impact of the shock is expected to be less for large firms since the continuation of the lending relationship is more valuable with a larger firm and large firms are expected to be more likely to find borrowing from other banks (see, e.g., Khwaja and Mian, 2008; Iyer et al., 2014). To investigate this, we repeat our regressions for firms with different sizes. We find a significant reduction in banks' loan supply in every size group where the reduction is lower for larger firms. This finding indicates that banks are more hesitant to decrease their loans to large firms. When we move to the firm level, we show that the negative shock does not lead to a significant reduction in the amount of total loans for large firms with more than 500 employees. This finding suggests that although large firms experienced a significant reduction in their loans from high-exposure banks, they could avoid a reduction in their total loans by switching to other banks.

As robustness checks, we first employ a placebo test and repeat our analysis for one year before the pandemic, and we find no statistically significant effect of bank exposure on the loan supply. This supports the pre-pandemic parallel trends. Second, we follow Degryse et al. (2019) and replace the firm $\times$ year-month fixed effects with industry $\times$ province $\times$ size $\times$ year-month fixed effects. This allows us to include single-bank firms in our analysis. The results are similar to our baseline estimates. Third, we include several bank characteristics as controls and show the results are robust. Fourth, in the firm-level analysis, we include the exposure of upstream and downstream industries to control for the effect of the shock on firms' suppliers and purchasers. Fifth, we repeat our firm-level analysis for firms with multiple banks to use the same sample from the bank-firm analysis. We find similar results.

Overall, our results establish the transmission of negative economic shocks, triggered by the COVID-19 pandemic, from affected industries to the rest of the economy. The transmission channel is through borrowing from the same bank: Firms from industries with different levels of the negative shock use the same bank as their lender and the bank transmits the shock across industries. As a result, negative economic shocks reduce bank lending even in unaffected industries. These results suggest that borrowing from the same bank establishes a transmission channel across industries and propagates negative economic shocks in an economy.

Our paper contributes to a large literature on the transmission of negative shocks via banks. Several articles study how a shock to the financial health of banks impact the real economy through banks' loan supply (see, e.g., Gan, 2007; Khwaja and Mian, 2008; Paravisini, 2008; Chava and Purnanandam, 2011; Dursun-de Neef, 2019). Some papers concentrate on the interbank linkages of banks as a source of propagation of negative shocks (see, e.g., Iyer and Peydro, 2011; Iyer et al., 2014; Cingano et al., 2016). Many others examine the international transmission of bank liquidity shocks (see, e.g., Peek and Rosengren, 2000; Cetorelli and Goldberg, 2011; Puri et al., 2011; Schnabl, 2012; De Haas and Van Horen, 2012; Hale et al., 2020). More recently, Imai and Takarabe (2011), Berrospide et al. (2016), Koetter et al. (2020) and Rehbein and Ongena (2020) study the spillover of shocks across geographical markets through bank lending channel and present evidence on a within-country version of "common lenders effect".[4] In our paper, we instead focus on the propagation of shocks across industries. Identifying the transmission of industry-level shocks through banks is highly relevant in understanding the contribution of the financial system to the interconnectedness of an economy. Despite the relevance of the question, to the best of our knowledge, there are no papers that study the transmission of industry-level shocks via banks as common lenders across industries. The reason behind this could be the challenge to find a shock that affect some industries and not others. By being an industry-specific negative shock that hit some

[4]See Kaminsky and Reinhart (2000) and Van Rijckeghem and Weder (2001) for a description of "common lenders effect" as a channel of contagion across countries during financial crises.

industries much worse than others, COVID-19 provides a unique framework to study this question. We fill the gap in the literature by providing the first evidence on the transmission of negative shocks across industries via banks where we exploit the COVID-19 pandemic as an industry-specific negative shock.

We also contribute to the literature on the propagation of industry level shocks by highlighting that industries are connected not only through input-output linkages but also through the financial system. The standard approach in this literature involves the analysis of industry specific shocks through cross-industry input and output tables (Acemoglu et al., 2012, 2016; Giannetti and Saidi, 2019; Alfaro et al., 2021). Atalay (2017) finds that the propagation of sectoral shocks through input-output networks contribute up to half of aggregate volatility. Empirical studies using region or sector specific shocks such as natural disasters similarly find that propagation through input-output linkages make-up the majority of the overall economic effects of these shocks (Barrot and Sauvagnat, 2016; Caliendo et al., 2018; Carvalho et al., 2021). The evidence we present shows that industry-specific shocks are transmitted not only through input-output linkages, but also through the financial system as firms from heterogeneously affected industries are linked by their outstanding loans at the same bank.

Finally, there is a growing literature that examines bank lending during the COVID-19 pandemic. These studies show changes in bank lending at the bank level. We contribute to this literature by providing evidence on banks' loan supply with a bank-firm level data that allows us to control for loan demand by including firm x year-month fixed effects. Li et al. (2020) show that large U.S. banks faced significant loan commitment drawdowns at the onset of the pandemic and they honored these drawdowns by providing liquidity to their borrowers as the lenders of first resort. Dursun-de Neef and Schandlbauer (2020) find that U.S. commercial banks located in counties with more severe outbreaks supplied more loans which was financed by an increase in their insured deposits. Similarly, Beck and Keil (2021) show that U.S. banks that were more exposed to the pandemic and the

lockdown policies faced an increase in their loss provisions and non-performing loans. For Europe, Dursun-de Neef and Schandlbauer (2021) provide evidence on the lending responses of European banks with a focus on bank capital. Schularick et al. (2020) estimate the capital shortfall of Eurozone banks in response to the COVID-19 crisis and propose that banks should recapitalize. As an evidence from Turkey, Cakmakli et al. (2020) provide a detailed sector-level analysis on the impact of the COVID-19 pandemic on the Turkish economy.[5]

The remainder of the paper is organized as follows. Section 2 describes the Turkish economy and the Turkish Banking system during the COVID-19 pandemic. Section 3 discusses the data, Section 4 describes the empirical methodology, and Section 5 presents the results. Section 6 concludes.

2 Institutional background

2.1 The COVID-19 pandemic and the Turkish economy

Following an exchange rate shock in August 2018, Turkey experienced a negative growth and high inflation in the first two quarters of 2019. Monetary and fiscal expansion led to a strong recovery in economic activity during the last quarter of 2019 and continued until February 2020. The recovery was in part driven by credit growth which was driven by the expansion in loans led by state-owned banks.

The positive atmosphere in the economy started to dissipate in March with the arrival of the COVID-19 pandemic. The first case in Turkey was detected on March 11 and the first death occurred on March 15. Turkey's initial response to COVID-19 was targeted. First, the authorities restricted flights from abroad and some land borders were closed. Thereafter, social distancing measures were taken. Starting on March 16, nonessential businesses and

[5]In addition to the studies above, Çolak and Öztekin (2021) study the effect of the pandemic on global bank lending focusing on banks from 125 countries.

schools were gradually shut down. Initially, Turkey chose to adopt partial lockdown strategy instead of a complete shutdown. Partial curfews were imposed for population over the age of 65 on March 22 and for population under the age of 20 on April 4. As these precautions did not provide a sufficient decline in the number of cases, a general curfew was imposed in 31 provinces on weekends between April 11 and May 3, in 23 provinces on May 9 and 10, in 15 provinces between May 16 and May 19, in 81 provinces between May 23 and May 26, and, finally, in 15 provinces on May 30 and 31. Although the number of cases remained high, presumably due to its young population, the number of deaths did not reach the heights seen in the EU countries. The evolution of the COVID-19 pandemic in terms of daily cases and deaths in Turkey is presented in Figure 1.

With the declining number of cases in May, restrictions were lifted and the economy reopened by June. However, the number of daily cases and deaths continued on an increasing trend beginning from September, and, on November 20th the second lockdown measures were announced which introduced curfew on people aged 65 and older, and aged twenty and younger. Similar social distancing measures as in the first lockdown were also taken during this period. The second period of restrictions lasted until March 2021.

Although the lockdowns were partial, real GDP shrank by 10.3 percent on an annual basis in the second quarter of 2020 due to the combined effect of the declines in exports, tourism and domestic demand. As COVID-19 hit the global economic activity, supply chains, trade networks and international transport, Turkey's export and tourism opportunities contracted, and the current account deficit increased. Declining export demand and containment measures led to a significant fall in manufacturing output. Unlike previous economic downturns, the service sector also shrank significantly. The reaction of firms to the decline in revenue was to lay off their employees, particularly informal workers which in return further decreased domestic demand.[6]

[6] According to Social Security Institute, approximately 30% of Turkish workers are employed informally. The social security measures intended to protect household incomes are largely applicable to formal sector employees.

Turkey's economic policy response to COVID-19 was targeted. The IMF estimates that in 2020, Turkey spent 1.9% of its GDP on fiscal stimuli and 9.4% of its GDP on monetary measures made up of equity, loans and guarantees. The former figure is below average while the latter is above average across emerging economies.[7] On the fiscal policy side, the first policy that was widely used was short-term working allowance. The number of employees receiving short-term working allowance reached to 3.3 million in May 2020. Another measure taken by the authorities was the introduction of the prohibition on the layoff of formal workers. Firms were not allowed to lay off their employees, but they were allowed to send them to unpaid leave and these employees were benefited from a cash fee support provided by the government. Finally, under a Social Support program by The Ministry of Family, Labor and Social Services, vulnerable households received a one-time cash transfer.

Instead of a fiscal response, the Turkish government opted to use the monetary policy channel more actively to soften the economic effects of COVID-19. For the pre-pandemic period, monetary policy was already on an easing cycle with 6 consecutive cuts to the policy rate, which fell from 24 percent in July 2019 to 10.75 percent in February 2020. Similar to other central banks, as a response to COVID-19, Central Bank of the Republic of Turkey (CBRT) lowered policy rate further three times to 8.25 percent in May 2020, and kept it at that level until September 2020. This had the effect of lowering the overall cost of financing in the economy.

In addition to easing the policy rate, the CBRT also took steps for liquidity injection. It purchased government securities on the secondary market, introduced longer-maturity (up to 91 days) repo transactions, extended currency swap transactions, and expanded the collateral pool for Turkish Lira and foreign exchange operations to include asset- and mortgage-backed securities (CBRT, 2020b). In the financial sector, state-owned banks significantly increased their outstanding loans. In order to ensure that the injected liquidity reached sectors worst hit by the COVID-19 shock, authorities introduced financial and macro-prudential measures.

[7]Up-to-date estimates can be seen from https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19.

Potentially due to these measures, economic activity experienced a significant demand-driven recovery in the third quarter of 2020 with a quarterly GDP growth of 6.4%. The recovery was widespread across all but the service sector, which was directly affected by the lockdown measures. In line with the rapid increase in consumer credit, private consumption increased significantly in the third quarter. However, increasing demand and the depreciation in the Turkish Lira resulted in increased inflation, which, in turn, led the CBRT to raise the policy rate in November and December 2020, up to 17 percent. On the fiscal policy side, in order to ease the negative effect of second lockdown introduced in November, short-term work allowance, prohibition on layoff of formal workers and cash transfers to vulnerable households policies were still kept in place. The Turkish economy grew by 5.9% in the last quarter and ended 2020 with 1.8 percent annual growth, the second highest growth rate worldwide following China.

2.2 The Turkish banking system during the COVID-19 pandemic

Turkey's financial system is bank-dominated. More than 95% of outstanding loans are provided by banks. The banking sector consists of state-owned and privately-owned banks. As of March 2020, there were 3 state-owned and 27 active privately-owned commercial banks in Turkey. Commercial banks primarily engage in corporate and consumer lending. They hold a share of 86% in the total credit supply. In addition to commercial banks, there are 6 participation (3 state-owned and 3 privately-owned) and 14 development and investment banks (3 state-owned and 11 privately-owned), which are smaller and have a total share of 14% in the total credit supply.

Although they are fewer in number, state-owned banks provided on average 43% of corporate lending in 2019 and 2020 as can be seen in Figure 2. Because they have state guarantees, the state-owned banks' objective function differs from conventional banks and they took an active policy role during the pandemic.[8] During the COVID-19 pandemic, state-

[8]The difference between privately-owned and state-owned banks is that state-owned banks are considered

owned banks were used to provide a subsidized mortgage loan package to boost economic activity.[9] In corporate lending, they increased their share of outstanding loans substantially with a large injection of liquidity to the non-financial sector during the early months of the pandemic (Figure 2).

In response to the COVID-19 pandemic, the Turkish government implemented a stimulus program aimed to raise the banks' liquidity, limit any deterioration in the corporate sector's cash flow, and preserve households' purchasing power. Figure 2 shows that credit stimulus packages initiated during this period, interest rate cuts by the CBRT and other regulatory measures raised lending by both private and state-owned banks but the majority of the increase in corporate loans was realized through state-owned banks. [10]

Survey evidence shows a significant rise in credit demand by firms during the pandemic. The main factors driving the rise in loan demand for the corporate sector were interruptions in cash flow and prudential liquidity demand. Monetary policy intended to expand liquidity was aimed at meeting this rise in demand. Figure 3 shows the results of the Bank Loans Tendency Survey (BLTS) conducted by the CBRT from June and September 2020, which confirm that debt restructuring was the most important factor in firms' loan demand during this period.

3 Data

We use data on industry revenues and credit card spending to calculate the size of the negative economic shock triggered by the COVID-19 pandemic. We estimate the impact of this shock on banks' loan supply using the Credit Register data that contain comprehensive monthly bank-firm level loan data, which is made available by the Central Bank of the Republic of Turkey. In our analysis, we focus on privately-owned banks since state-owned

as a safe haven because the government can inject capital into state-owned banks if their buffers are eroded (Marois and Güngen, 2016).

[9]See Akgunduz et al. (2021) for further information and an analysis of the mortgage subsidy.

[10]For more details on financial measures taken during the pandemic, see the Financial Stability Report of May 2020 (Box I.1.I) (CBRT, 2020a).

banks have less binding financial constraints and, as a result, their loan decisions are not expected to be negatively affected by the prospect of non-performing loans. Thus, we have 27 privately-owned commercial banks in our sample. The credit register data is further linked to firm balance sheets from 2019 collected by the Revenue Administration and firm-level annual employment collected by the Social Security Institute, which allows us to obtain information about firm size, sector, location, sales, and exports. We additionally merge the credit register data to the bank balance sheets from 2019 collected by the Banking Regulation and Supervision Agency to be able to include bank size, equity, non-core funding, liquid assets, return on equity (ROE), and non-performing loans as further controls. We finally link the resulting dataset to quarterly income statements from the first, second, and third quarters of 2020 to estimate the impact on firm sales. Throughout the study, we use data from the years 2019 and 2020.[11]

3.1 Estimating the size of the COVID-19 shock

We divide industries into tradable (manufacturing) and non-tradable (service) industries. We construct shocks at the industry level for tradable industries and at the industry-province level for non-tradable industries, where an industry is defined as the 2 digit NACE-2 level. Two datasets are used to measure the size of the shock: 2 digit NACE-2 level revenue indexes for tradable industries and credit card spending data for non-tradable industries.

For tradable industries, the Turkish Statistical Institute releases revenue indexes at the 2 digit NACE-2 level for each month. Revenue indexes are further divided into domestic and export revenues. We deflate each with producer price indexes, which are also released monthly for domestic and export prices. We calculate the year-on-year changes as changes in revenue indexes relative to the same month in the previous year. This enables us to measure the exposure of each industry to the shock by adjusting for seasonal variation in the revenues. The overall domestic and export revenue indexes are shown in Figure 4. We

[11] When we present the parallel trends in banks' loan supply during the pre-pandemic period in Section 4, we additionally use the 2018 data for the placebo test reported in Figure 9.

measure the economic shock to each industry in tradable industries as the average decline in domestic and export revenues in April and May 2020, the two months when the size of the decline in revenues was largest as shown by the light gray area in Figure 4. The fall in domestic revenue exceeds 25% while the fall in export revenue reaches 40% in April.

There is significant variation in our shock measure across industries as seen in Figure 5. Domestic revenues fell most in leather manufacturing industries - by more than 50%. It is followed by textiles and wearing apparel manufacturing industries by a more than 40% drop. Export revenues fell most in the manufacture of motor vehicles and trailers by almost 60%. On the other hand, some industries were not affected at all like the food processing industries. Some other relatively less affected industries are the manufacturing of paper and petroleum products. In addition, there was a significant increase in the export revenues of the pharmaceutical products industry by more than 20%.

To measure the size of the shock in non-tradable industries, we use daily credit card spending data made available by the Banks Association of Turkey. Household Finance and Consumption Survey (HFCS) show that around 54% of Turkish households use a credit card, suggesting that changes in credit card spending can be a reliable proxy for consumption. The credit card spending data is aggregated at the level of around 250 spending categories for each of the 81 provinces located in Turkey. We manually match these spending categories to 2 digit NACE-2 level non-tradable industries and calculate the year-on-year changes in monthly credit card spending for each industry-province. Figure 6 shows that credit card spending declined by more than 20% during April and May 2020. We use the average decline in credit card spending in these two months for each industry-province pair to measure the economic shock to each industry-province pair in non-tradable industries. There is significant variation in our shock measure across provinces and industries as presented in Figures 7 and 8. Figure 7 shows that while tourist destinations like Antalya, Mugla and Nevsehir experienced declines in credit card spending exceeding 40%, some Eastern provinces were unaffected. Industry level changes in credit card spending are shown in Figure 8. While tourism and

catering industries were hit hard, industries like telecommunications were unaffected.

Combining tradable sector revenue indexes and the credit card spending data provides an overview of the effects of COVID-19 shock on the economy in Turkey. However, we do not have information on the revenues of all industries. In particular, agriculture, mining, energy and construction related sectors are excluded from the final analysis due to a lack of data.[12] The tradable and non-tradable industries that are included in the estimation account for nearly 80% of all commercial loans issued by Turkish banks in our sample. Since the excluded industries are heavily regulated, we expect that the COVID-19 shock would have only limited impact on the revenues of these industries.

3.2 Estimating the bank-level exposure

When we calculate the bank-level exposure to the negative economic shock, we measure each bank's exposure to the shock through its pre-existing short-term loans in each industry. We focus on short-term loans since short-term loans are expected to mature in one year and expose banks to realized losses faster.[13] We expect that firms operating in the industries with large revenue declines would struggle to pay back their loans and, as a result, the banks that had larger amounts of outstanding short-term loans in these industries would have higher exposure to the shock due to either realized or expected loan losses.

The Credit Register data that contain comprehensive bank-firm level loan information is merged with the firm balance sheet data from the end of 2019 to identify each firm's industry and location. In order to capture the exposure of each bank to struggling industries at the onset of the COVID-19 crisis, we use each bank's pre-pandemic short-term loan portfolio shares in each industry for tradable sectors and in each industry-province pair for

[12]Some minor service industries are also excluded including NACE codes 70 (consultancy services), 72 (scientific research activities), 87 (full-time care) and 90 (creative arts).

[13]We repeat our analysis using banks' pre-existing total loans in each industry to measure their exposure to the shock. The results are reported in Tables A2 and A3 in the Internet Appendix. The results with this alternative exposure measure are similar but the captured effect is smaller. When we include both measures in the same regression as reported in Table A1, one can see that the impact comes solely from the exposure measured by banks' pre-existing short-term loans. Hence, we use pre-existing short-term loan portfolios to measure the bank-level shock.

non-tradable sectors, where the pre-pandemic short-term loan portfolio is calculated for the month of December 2019. Given that banks were not aware of the coming pandemic by the end of 2019, it was a complete shock for them when the pandemic hit the revenues of their borrowers. This makes the COVID-19 pandemic a valuable opportunity to study the transmission of the negative economic shock across industries through the bank lending channel.

As described in Section 3.1, in tradable sectors, we define the economic shock of each industry by the decline in domestic and export revenues in that industry. To calculate a weighted-average exposure, we use the pre-pandemic fraction of domestic sales and exports in total sales for firms of each bank as weights. The exposure of bank i to the negative shock from industry n is calculated as

$$Exposure_{i,n} = \frac{DomesticSales_{i,n}}{AllSales_{i,n}} Exposure_n^d + \frac{Exports_{i,n}}{AllSales_{i,n}} Exposure_n^e, \tag{1}$$

where $DomesticSales_{i,n}$ ($Exports_{i,n}$) is the total domestic sales (exports) of firms operating in the industry n that bank i had an outstanding loan at the end of 2019 and $Exposure_n^d$ and $Exposure_n^e$ are the economic shocks defined at the domestic and export level for industry n in a tradable sector.

In non-tradable industries, on the other hand, we define the economic shock at the industry-province level, $Exposure_{n,p}$, by using the decline in credit card spending in each industry-province pair. To calculate the weighted average exposure of bank i to industry n, we use the pre-pandemic fraction of bank loans originated in each province for firms operating in that industry as weights:

$$Exposure_{i,n} = \sum_p \frac{Loans_{i,n,p}}{Loans_{i,n}} Exposure_{n,p}, \tag{2}$$

where $Loans_{i,n,p}$ is the amount of short-term loans issued by bank i for firms operating in industry n and province p, and $Loans_{i,n}$ is the total amount of short-term loans issued to

industry n at the end of year 2019.

The total exposure of bank i to the economic shock from industries operating in tradable and non-tradable industries is calculated as the weighted sum:

$$Exposure_i = \sum_n \frac{Loans_{i,n}}{Loans_i} Exposure_{i,n}, \tag{3}$$

where $Loans_i$ is the total outstanding loans of bank i at the end of year 2019 and $Exposure_{i,n}$ is the exposure of bank i to the economic shock in industry n, which is defined as in equation (1) for industries in tradable sectors and as in equation (2) for the ones in non-tradable sectors. To take into account the fact that not all loans of a bank are given to firms, the total outstanding loans variable in the denominator, $Loans_i$, includes both commercial and consumer loans. Thus, the bank-level exposure is defined as the loan-weighted percentage fall in revenues for firms in banks loan portfolio.

Table 3 shows the correlation between the bank-level exposure variable and the bank characteristics from December 2019 for all 27 banks in our sample. It is important to note that we find no significant correlation between the ratio of non-performing loans at the end of 2019 and the exposure variable, which suggests that the banks that had outstanding short-term loans to sectors exposed to the pandemic were not more risk seeking before the pandemic started. We also find no statistically significant association between exposure and any of the standard bank characteristics such as return on equity (ROE), liquidity, non-core funding, equity and bank size. This supports our assertion that the pandemic and its heterogenous effect across industries was an unexpected shock for banks.

3.3 Outcome variables and final sample

We analyze outcomes at two levels: bank-firm level and firm level. Our sample consists of bank-firm linkages between the population of incorporated firms that existed at the end of

2019 and privately-owned commercial banks.[14] We exclude firm-bank-month level observations that have a loan value of less than 100 TL.[15] Since bank-firm level regressions include firm x year-month fixed effects, only firms that have links to multiple banks are included in the sample. While there are 348,485 firms, this number is reduced to 176,628 once firms borrowing from a single bank are excluded. On average, each firm borrows from slightly more than 2 privately-owned banks. The firm-level sample consists of 299,139 firms, which includes all firms that are observed at least twice during the sample period.[16]

At the firm-bank level we estimate the effects on total, short-term and long-term loans. At the firm level, we further analyze the impact on the number of banks that firms are borrowing from, the share of loans from state-owned banks, and the weighted average exposure of firms via their banks. The relevant summary statistics for all outcome variables are presented in Tables 1 and 2.

4 Empirical methodology

Our interest is on estimating the transmission of negative economic shocks from affected industries to the rest of the economy by a reduction in banks' loan supply. We exploit the COVID-19 pandemic as an exogenous negative shock on the revenues of firms operating in affected industries. We use a difference-in-differences estimation method to compare lending before (Jan 2019 - Feb 2020) and after the COVID-19 pandemic (Apr 2020 - Sep 2020) among banks with different exposure to the affected industries. To control for loan demand, we follow Khwaja and Mian (2008) and exploit a comprehensive monthly bank-firm level loan data from Turkey - credit register data provided by the Central Bank of the Republic of Turkey. Similar to Jiménez et al. (2012), Jiménez et al. (2014) and Baskaya et al. (2017),

[14]Since we do not have balance sheet information for sole proprietorships and non-incorporated businesses, these are necessarily excluded from the sample. These make-up around 10% of the total revenue and the outstanding loans.

[15]Excluding loan values less than 500 or 1000 TL lead to very similar results.

[16]We repeat our analysis by excluding firms with a single bank that are not included in the firm-bank level analysis as a robustness check and the results are similar as shown in Section 5.2.

instead of using a two-period model, we use a multi-period estimation model which allows us to present changes in banks' loan supply for each month from April until September 2020.

We saturate estimation models with firm × year-month fixed effects so that we can control for changes in the loan demand (Khwaja and Mian, 2008). By including firm × year-month fixed effects, we focus on firms that borrow from multiple banks with different exposure to the COVID-19 shock. Within the same firm, we compare the changes in the loan supply by banks with different exposure. We investigate whether the same firm experienced a relative decrease in the amount of loans issued by a bank with higher exposure compared to another bank with lower exposure. Moreover, we control for firm × bank fixed effects to absorb any time-invariant unobserved characteristics for firm-bank pairs (Baskaya et al., 2017).

Our estimation model is structured as follows:

$$log(Loans_{i,j,t}) = \alpha Exposure_i \times Post_t + \delta_{j,t} + \delta_{i,j} + u_{i,j,t}, \tag{4}$$

where $log(Loans_{i,j,t})$ is the logarithm of total loan amount of firm j from bank i in year-month t, $\delta_{j,t}$ are firm × year-month fixed effects, and $\delta_{i,j}$ are bank × firm fixed effects. $Exposure_i$ measures bank i's exposure to the shock and is calculated as in equation 3. The time period captures twenty months from January 2019 to September 2020 excluding March 2020.[17] $Post_t$ takes a value of one for the post-pandemic period from April 2020 to September 2020 and zero for the pre-treatment period from January 2019 to February 2020. We cluster the standard errors at the bank × year-month level.[18]

In addition, we estimate changes in banks' loan supply for each month separately by using the following model:

$$log(Loans_{i,j,t}) = \sum_{m=1}^{6} \alpha_m Exposure_i \times Month_{m,t} + \delta_{j,t} + \delta_{i,j} + u_{i,j,t}, \tag{5}$$

[17] We exclude March 2020 from our analysis since the first case in Turkey was detected on March 11, 2020. This makes the first half of the month pre-pandemic and the second half post-pandemic.

[18] Undisclosed results show that clustering at the firm level yields similar results with smaller standard errors.

where $Month_{m,t}$ takes the value of one for the specific month m in the post-treatment period and zero for the pre-treatment period, e.g., $Month_{1,t}$ takes the value of one for April 2020 and $Month_{6,t}$ takes the value of one for September 2020.

To employ a difference-in-differences estimation method, we first need to show that banks with different exposure to the negative shock had similar changes in their loan supply before the pandemic started, i.e., the parallel trends. This suggests that, in the absence of the pandemic, exposure to these industries would not lead to a differential impact on the changes in banks' loan supply. The impact comes from the exogenous effect of the pandemic on these industries' revenues and, as a result, on firms' ability to pay their existing loans. To check whether they have parallel trends before the pandemic, we falsely assume that the pandemic started in March 2019 and repeat our analysis with a post-pandemic period from April to September 2019 and a pre-pandemic period from January 2018 until February 2019. The estimated coefficients for each month are shown in Figure 9. None of the monthly coefficients are statistically significant and we detect no effect from exposure on bank loan supply in 2019. This supports the parallel trends assumption that banks with different exposure to the negative shock had parallel trends in their loan supply before the pandemic.

We next move to the firm-level analysis to estimate the impact of the shock on firms' total loans to investigate whether firms could smooth out the impact by switching from high-exposure banks to low-exposure banks. At this level, we cannot include firm $\times$ year-month fixed effects, we instead control for loan demand by saturating our model with industry $\times$ province $\times$ year-month fixed effects which enables us to account for all time-varying observed and unobserved characteristics for industry-province pairs that might be correlated with changes in loan demand for that industry in that province. This ensures that we compare changes in the total amount of loans for firms with heterogeneous levels of exposure to the shock via their banks within the same industry. Moreover, we include firm fixed effects to absorb all time-invariant observed and unobserved firm characteristics.

We structure our firm-level estimation model as follows:

$$log(Loans_{j,t}) = \alpha Exposure_j \times Post_t + \delta_j + \delta_{n,p,t} + u_{j,t}, \tag{6}$$

where $log(Loans_{j,t})$ is the logarithm of total loan amount of firm j from all banks in year-month t, δ_j are firm fixed effects, and $\delta_{n,p,t}$ are industry $\times$ province $\times$ year-month fixed effects. $Exposure_j$ measures firm j's exposure to the shock via its banks, which is calculated as the weighted average exposure of its banks, where the weights are the pre-pandemic loan portfolio shares that are borrowed from each bank. As already mentioned in Section 3.2, our focus is on privately-owned banks since state-owned banks have limited financial constraints and their lending decisions are not expected to be affected by the shock. Thus, the firm-level exposure is calculated as

$$Exposure_j = \sum_i \frac{Loans_{i,j}}{Loans_j} Exposure_i, \tag{7}$$

where the weights are the pre-pandemic loan portfolio shares calculated as the amount of loans issued by each privately-owned commercial bank, $Loans_{i,j}$, divided by the total volume of loans issued by all privately-owned commercial banks to firm j, $Loans_j$, where both are calculated at the end of 2019. This firm-level exposure measure estimates the weighted average exposure of all privately-owned commercial banks that the firm had an outstanding loan before the pandemic started.

In addition, we estimate changes in firms' total loans for each month separately similar to equation 5:

$$log(Loans_{j,t}) = \sum_{m=1}^{6} \alpha_m Exposure_j \times Month_{m,t} + \delta_j + \delta_{n,p,t} + u_{j,t}. \tag{8}$$

5 Empirical Results

This section presents the empirical results. To show whether banks transmit negative economic shocks from affected industries to the rest of the economy, we proceed in two steps. First, we start with bank-firm level and analyze whether banks with higher exposure to the negative shock reduce their loan supply relative to banks with lower exposure by studying the change in the loan supply to the same firm in the same month. Second, we move to firm level and examine whether firms borrowing from high exposure banks experience a decrease in their total amount of loans. This enables us to investigate whether firms are able to avoid a reduction in their loans by switching to banks with low exposure.

5.1 Transmission from banks to firms

To motivate our analysis, we present a plot of the monthly change in banks' average loan supply for high and low exposure banks. Banks with levels of exposure above median are defined as high-exposure banks and the rest of the banks as low-exposure banks. As shown in Figure 10, banks with high exposure to the negative economic shock decreased their lending significantly more relative to other banks. The largest drop happens in May and June 2020. This graph also shows evidence for the parallel trends between these two types of banks before the pandemic. This supports the argument that the shock was exogenous to the banks and otherwise similar banks changed their loans with the severity of the shock although they show similar changes in their lending right before the shock.

Table 4 presents the firm-bank level results estimating the model specification from equation 4. Column (1) shows the effect of the negative shock on banks' loan supply. We find that a 1 percentage point increase in a bank's exposure to the negative shock leads to a 6.64 percent reduction in the amount lent by that bank. This is statistically significant and economically relevant: A 1 standard deviation increase in banks' exposure results in a lending cut by almost 8 percent. Columns (2) and (3) present the effect on the short- and long-term

loan supply, respectively. There is a significant reduction in both types of loans: Banks with a 1 percentage point higher exposure decreased their short-term loans by 7.82 percent and their long-term loans by 9.36 percent.

When we study the change in each month separately as in equation 5, we find that the negative shock leads to a significant reduction in banks' loan supply in each month from April to September 2020. According to our results reported in Panel B of Table 4, a 1 percentage point increase in a bank's exposure to the negative shock led to a significant drop in its loan supply by 3.77 percent in April. The impact of the negative shock on lending increased over time where it reached a reduction of 7.42 percent in September. The effect on short- and long-term loan supply followed a similar pattern. For short-term loans, a 1 percentage point increase in the exposure to the shock led to a reduction of 2.89 percent in April which increased to a reduction of 10.12 percent in September. For long-term loans, the reduction in April was much larger at 8.54 percent which became 10.78 percent in September.

We plot the changes in the coefficient estimates for each month over time in Figure 11. Using an alternative specification where we use December 2019 as the control month and estimate the coefficients for each month starting in January 2020, we show that the estimates are not significantly different than zero until March and that they become significantly negative starting in April. As shown in Figure 11, the impact of the shock on loan supply increases gradually from April to September. We report these coefficients in column (1) of Table 5. Columns (2) and (3) report the coefficients for short- and long-term loans. They both follow a similar pattern. The only difference is that the reduction in the long-term loan supply becomes slightly significant in February and already highly significant in March. This might imply that banks started to cut their long-term loan supply already in February and March by being concerned about the possible effects of the COVID-19 pandemic.

So far, we have shown that banks, on average, reduced their loan supply to firms when they had higher exposure to the negative shock. Given that the negative shock is industry specific, the next interesting question is whether banks reduced their loan supply to firms

operating in unaffected industries as well. If this is the case, this finding would suggest that banks transmit the negative economic shock that originated in one industry to another industry by a reduction in their loan supply. To investigate this, we divide our sample into more- and less-affected industries, where more-affected industries are the industries that had a shock that is above median and the rest is defined as less-affected industries. According to the results reported in Table 6, banks with higher exposure to the shock decreased their loan supply significantly to firms operating in both more- and less-affected industries similarly. As shown in columns (1) and (4), a 1 percentage point increase in banks' exposure to the negative shock led to a significant reduction in their loan supply by 6.9 percent for firms in less-affected industries and by 6.44 percent for firms in more-affected industries. The reduction in short- and long-term loan supply is also similar as reported in columns (2), (3), (5) and (6): a 1 percentage point higher exposure decreases short-term (long-term) loan supply by 7.7 percent (10.39 percent) for less-affected industries and by 7.77 percent (9 percent) for more-affected industries. These results imply that the reduction in banks' loan supply is of similar size across firms operating in more- and less-affected industries. This suggests that the negative economic shock was transmitted from more- to less-affected industries through a reduction in banks' loan supply.

We next examine whether firm size matters. The impact of a negative shock on banks' loan supply is expected to be less to large firms since the continuation of the lending relationship is more valuable with a larger firm relative to a small firm (see, e.g., Khwaja and Mian, 2008; Iyer et al., 2014).[19] To investigate this, we repeat our regressions for firms with different size groups where the number of employees of 250, 500 and 1000 are used as thresholds. According to our results reported in Table 7, we find a significant reduction in banks' loan supply in every size group, yet the impact of the shock is decreasing as the firm size increases: a 1 percentage point increase in banks' exposure led to an almost 7 percent reduction in loan supply to SMEs with below 250 employees, whereas the reduction

[19]See Yarba and Güner (2019) and Yarba and Güner (2020) for evidence on Turkish banks.

is 1.8 percent to large firms with above 1000 employees. This finding indicates that banks are more hesitant to decrease their loans to large firms, which is in line with the literature. The following interesting question is whether the large firms that experienced a significant reduction in their loans from highly exposed banks could avoid the reduction in their total loans by borrowing from less exposed banks. We answer this question in Section 5.2 when we present the firm-level results.

In our main analysis, we include firm × year-month fixed effects in our regressions to control for loan demand. This setting restricts our analysis to firms with multiple banks as lenders and excludes all firms with a single-bank. As a robustness test, we follow the proposition of Degryse et al. (2019) and replace the firm × year-month fixed effects in the baseline specification with industry × province × size × year-month fixed effects.[20] While the latter fixed effect is a less precise control for demand side factors, it allows us to estimate the effects for both multi- and single-bank firms. The results are presented in Table 8. The estimates are quantitatively similar to our baseline estimates.

Pre-pandemic bank characteristics such as capital, liquidity and non-core funding might have played a role in banks' loan supply during the pandemic.[21] To investigate this, we include several bank characteristics such as non-performing loans, return on equity (ROE), liquidity, non-core funding, equity and bank size as controls in our regressions. As reported in Table 9, the coefficient estimate on the exposure measure does not change when we include bank controls. In addition, the literature shows that high liquidity on bank balance sheets help affected banks to continue the provision of their loan supply during crises (see, e.g., Puri et al., 2011; Cornett et al., 2011). We next investigate whether high-exposure banks' liquid assets enabled them to mitigate the reduction in their loan supply when they faced the COVID-19 crisis. We repeat our analysis for low- and high-liquidity banks separately. Banks

[20]For this exercise, we define size as an indicator variable for whether the firm is larger or smaller than 250 employees at the end of 2019.

[21]Several studies show that banks with more capital, higher liquidity and lower non-core funding cut their lending significantly less during the global financial crisis (see, e.g., Ivashina and Scharfstein, 2010; Puri et al., 2011; Cornett et al., 2011; Dagher and Kazimov, 2015; Dursun-de Neef, 2019).

with liquid assets to total assets ratio above median are defined as high-liquidity banks and the ones below median as low-liquidity banks. According to the results reported in Table 10, low-liquidity banks decreased their loans significantly more relative to high-liquidity banks. A 1 percentage point increase in the exposure led to a reduction in banks' loan supply by 9.1 percent for banks with low liquidity and by 5.02 percent for banks with high liquidity. This result is in line with the findings of the literature that liquid assets on bank balance sheets can shield banks from negative shocks and help them to alleviate the reduction in their loan supply.

5.2 Firm-level effects

To investigate whether firms that experienced a significant reduction in their loans from highly-exposed banks could avoid a reduction in their total loans by switching to banks with less exposure, we next study the impact of the negative shock on firms' total loans. In the firm-level analysis, we define a firm-level weighted average bank exposure measure, where the weights are the pre-pandemic loan portfolio shares that are borrowed from each bank, as shown in equation 7. Firm-level results are reported in Table 11. Panel A shows the main post-pandemic results from regression specification in equation 6. According to our results, firms that have a higher exposure to the negative economic shock through their banks experienced a significant reduction in the amount of their loans. As reported in column (1), a 1 percentage point increase in the exposure leads to an almost 4 percent drop in firms' total loans.[22] This implies that firms, on average, could not avoid a reduction in their loans by switching to banks with less exposure to the negative shock. However, it is essential to note that the reduction we capture at the firm level is much smaller than the reduction at the bank-firm level, implying that firms could mitigate some but not all the effects. Panel B of Table 11 reports the monthly changes separately. The results show that the reduction in firms' total loans was significant for all months from April to September

[22]Given that firms' average exposure to the negative shock was 0.025, this result suggests that firms on average experienced an almost 10 percent reduction in their total loans.

where the reduction increases over time: Firms with a 1 percentage point higher exposure experienced a significant drop of 1.42 percent in April and of 5 percent in September.

Next, we calculate a time-varying exposure for firms, where we use the time varying loan portfolios of firms, instead of their pre-pandemic loan portfolios, to calculate the weighted average exposure at the firm level. As shown in column (2) of Table 11, we find that the firms with higher exposure to the shock experienced a larger decrease in the fraction of their loans from more exposed banks and, as a result, their exposure to the economic shock decreased. The decrease in their exposure becomes more pronounced over time as reported in Panel B. Consistent with this finding, we also show that the number of banks that each firm borrows from is decreasing as the firm's exposure to the shock increases. According to the coefficient estimate reported in column (3) of Table 11, a 1 percentage point increase in a firm's exposure to the negative shock decreases the number of banks that it is borrowing from by 1.8 percent. This decrease in the number of banks becomes stronger over time as shown in Panel B.

During the pandemic, the Turkish government supported firms by providing liquidity through state-owned banks. We are interested in examining whether firms were able to smooth out the reduction in their borrowing by getting loans from state-owned banks. To investigate this, we study the changes in the fraction of loans that are issued by state-owned banks in a firm's portfolio. As reported in column (4) of Table 11, we find that firms with higher exposure to the negative shock through their banks experienced a significant increase in the share of their loans from state-owned banks. A 1 percentage point increase in firms' exposure to the shock increased the share of their loans from state-owned banks by 0.16 percent. We expect that state-owned banks are more likely to issue loans to the borrowers that they had an existing lending relationship in the pre-pandemic period. To study this further, we divide firms into two as the firms that had a positive outstanding loan from a state-owned bank at the end of 2019 and the firms that had loans only from privately-owned banks. The results for these two groups are reported in Table 12. We find that firms that had

an existing lending relationship with a state-owned bank experienced a significant increase in the fraction of their loans from state-owned banks, whereas the other group experienced a significant decrease in the share of their loans from state-owned banks. As reported in column (8), a 1 percentage point increase in a firm's exposure to the shock led to an increase in the fraction of its loans from state-owned banks by almost 0.5 percent if the firm had an existing relationship with a state-owned bank before the pandemic. We next investigate whether this enables these firms to mitigate the reduction in their loans. As shown in columns (1) and (5), we find that the reduction in the loans is significantly less for firms that had an existing relationship with a state-owned bank: Banks with a 1 percentage point higher exposure to the shock experienced a significant decrease in their loans by almost 5 percent if they didn't have a lending relationship with a state-owned bank, whereas the reduction was 2.9 percent if they had an existing relationship. This finding implies that the state-owned bank loans helped firms that had an existing relationship with them to reduce the effect of the shock by almost half. This suggests that the provision of liquidity by the Turkish government through state-owned banks allowed these firms to alleviate the impact of the negative shock.[23]

In the previous section, we present that banks transmitted the negative shock from more-affected industries to less-affected industries by reducing their loan supply significantly to firms in less-affected industries. We next investigate whether this result holds at the firm-level as well. We expect that firms operating in less-affected industries are more likely to find banks that are willing to issue loans to them as banks might be more hesitant to give out loans to firms in more-affected industries and instead provide loans to firms in less-affected industries. As a result, the impact of the shock might be less significant for firms from less-affected industries. To examine this, we divide the firms into more- and less-affected industries, and study the differential impact of the shock on the firms operating in industries with different exposure levels. According to our findings presented in Table 13, firms in both types of industries experienced a significant reduction of similar magnitudes in their

[23]These findings are in line with the findings of Li and Strahan (2020) on the importance of relationship lending for the supply of credit under the Paycheck Protection Program (PPP) during the pandemic.

loan supply. The reduction is 4.22 percent for firms operating in less-affected industries and 3.68 percent for firms in more-affected industries. This result suggests that the shock led to a significant reduction in firms' total loans not only in more-affected industries but also in less-affected industries.

According to the literature, large firms are expected to be more likely to find alternative borrowing opportunities from other banks (see, e.g., Khwaja and Mian, 2008; Iyer et al., 2014). We next study whether large firms were able to alleviate the impact of the shock by switching to other banks. The results by firm size are reported in Table 14. We find that the impact of the shock on the amount of total loans is significantly negative for only small firms with the number of employees below 500 as shown in columns (1) and (2). On the other hand, the negative shock does not lead to a reduction in the amount of loans for large firms with the number of employees above 500 as reported in columns (3) and (4). This result is consistent with the literature. Combining this with the findings in the previous section, we show that although large firms with above 500 employees experienced a significant reduction in the amount of their loans from banks with high exposure to the negative shock as reported in column (3) of Table 7, they did not have a reduction in their total loans as presented in column (3) of Table 14. This result implies that these firms could switch to borrowing from other banks and avoid a reduction in their total loans.

One might argue that the shock might affect the firms through the industries that their suppliers or purchasers are operating. To control for this possible channel, we additionally include the shock exposure of upstream and downstream industries in the regressions. We measure the shock exposure of upstream industries of a firm by calculating a weighted-average exposure of the industries that the firm's suppliers are operating in, where the weights are the fraction of supplies from each industry. Similarly, the exposure of downstream industries is calculated as the weighted-average exposure of purchaser industries. The results are reported in Table 15. Controlling for upstream and downstream industries' exposure to the shock does not change the effect of the exposure via banks.

As an additional robustness check, we focus on firms that borrow from multiple banks. This corresponds to the same sample of firms that are included in our regressions from bank-firm level analysis with firm × year-month fixed effects. We expect that the firms with multiple borrowers are larger than the firms with one borrower and, thus, the impact of the shock might be less strong for firms with multiple borrowers. The results on firms with multiple borrowers are presented in Table 16. As expected, we find a slightly less impact on them, where the impact is still highly significant and economically relevant: A 1 percentage point increase in the firm-level exposure led to a reduction of 2.1 percent in the amount of total loans as reported in column (1) of Table 16.

As a final analysis, we investigate whether firms with higher exposure to the negative shock through their banks cut their sales as a result of the reduction in their loan supply. To study this, we use firms' quarterly reports on their sales for the first three quarters of 2020 and define Q2 and Q3 of 2020 as the post period and Q1 of 2020 as the pre-treatment period. We then repeat the same analysis as in equation 6 at the quarterly level for the first three quarters of 2020. To further estimate the direct effect of the shock on firm sales, we additionally include the industry exposure of each firm in the regressions, where we omit the industry × province × year-month fixed effects. Our results are reported in Table 17. Firms with a 1 percentage point higher exposure to the negative shock through their banks experienced a significant drop in their sales by 0.9 percent in Q2 and by 0.8 percent in Q3 relative to Q1 of 2020. As reported in columns (2) and (3) of Table 17, we find that the impact of the exposure on firm sales is significant only in Q3 for tradable industries, whereas firms in non-tradable industries significantly decreased their sales already in Q2. This suggests that the transmission of the shock to firm sales is faster for non-tradable industries.

6 Conclusion

Our main contribution to the literature is to show that negative economic shocks affecting certain industries can be transmitted to the rest of the economy through bank lending. This transmission can be identified due to the suddenness and the heterogeneity of the industry level shocks caused by the COVID-19 pandemic. Since we can safely assume and confirm with a number of robustness tests that there was no way of expecting and adjusting loan portfolios according to the pandemic, banks with more outstanding loans to affected industries faced a greater prospect of non-performing loans. The results suggest that these banks then reduced their loans to firms including the ones operating in unaffected industries. This indicates that banks propagated the negative shock from affected industries to unaffected industries by a reduction in their loan supply.

According to our results, large firms with above 500 employees could avoid a reduction in their total loans by switching to other banks with less exposure. Small firms, on the other hand, had a large drop in their overall lending. In addition, firms with an existing relationship to a state-owned bank could significantly alleviate the impact of the shock by increasing their loans from state-owned banks, yet they still experienced a statistically significant reduction in their total loans. As a result of the shock, firms that had an outstanding loan from banks with higher exposure decreased their sales further.

Our findings highlight the interconnectedness of the economy, not only through direct supply linkages as has been documented by recent literature, but also through financial intermediaries. When there is a large negative shock to the economy, such as the one experienced during the COVID-19 crisis, banks are directly affected due to their exposure to the worst hit industries and, in turn, they affect the rest of the economy including the unaffected industries. The natural reaction of most governments during the pandemic was to support firms in industries that were directly hit by the pandemic. Our results offer a justification for monetary policies aimed at the economy at large rather than interventions to specifically affected industries.

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Figures

Figure 1. COVID-19 pandemic in Turkey
This figure shows the number of daily deaths from COVID-19 and the number of patients that are diagnosed by COVID-19 from March 2020 until April 2021. The data is provided by the Turkish Ministry of Health.

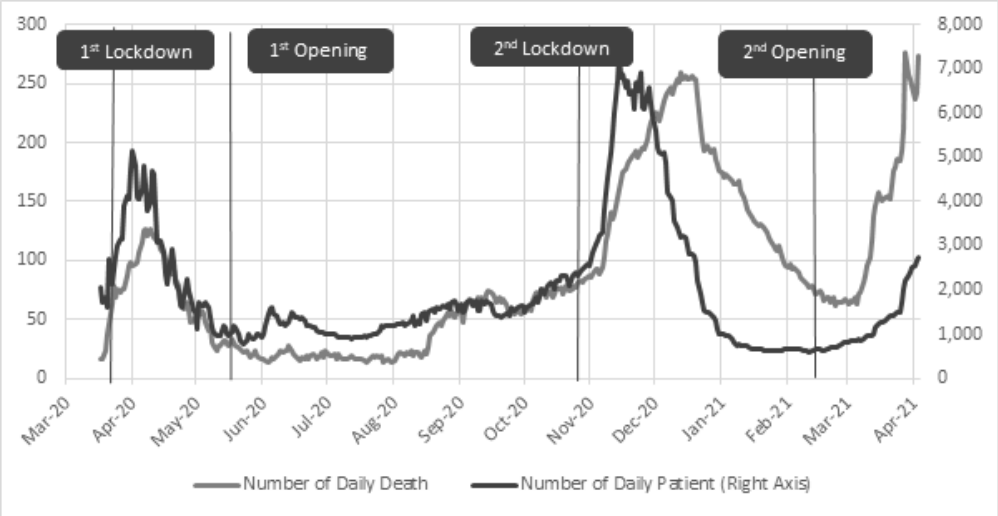


Figure 2. Loans of privately-owned and state-owned banks
This figure presents the total volume of loans to the non-financial sector issued by privately-owned and state-owned banks, and the share of total loans issued by state-owned banks. The vertical line is placed at the beginning of April 2020. The left-axis values are in nominal Turkish Liras.

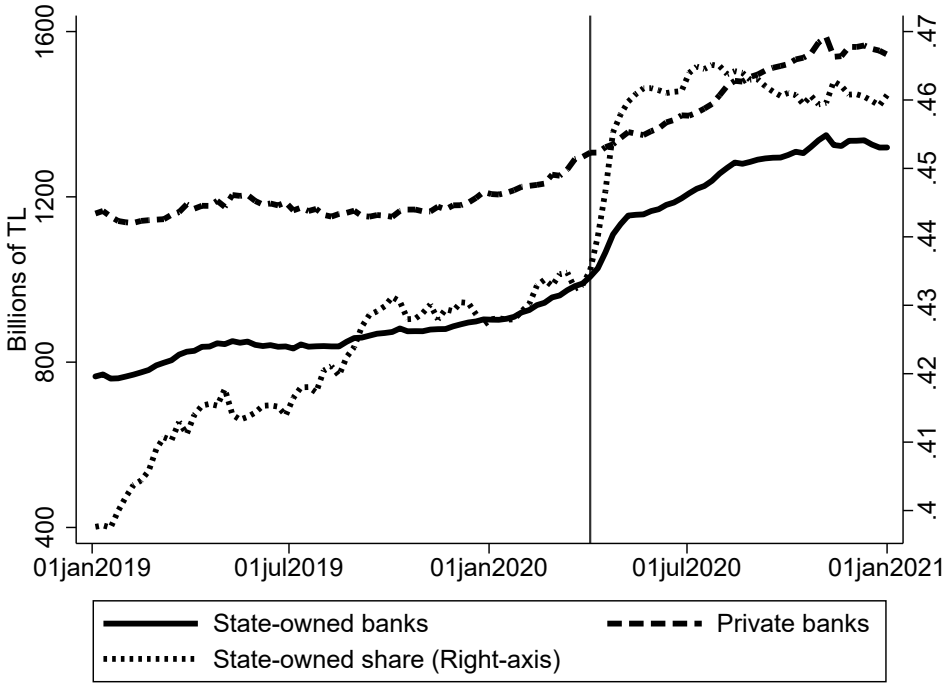


Figure 3. Changes in firm credit demand by motivation
This figure shows the year-on-year change in credit demand by motivation. The data is from the Bank Loans Tendency Surveys of July and September 2020.

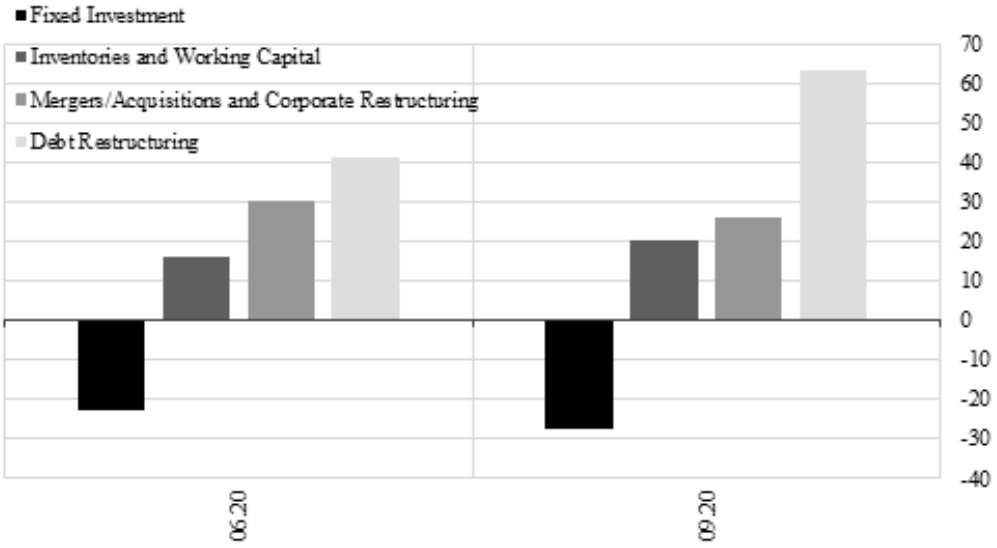
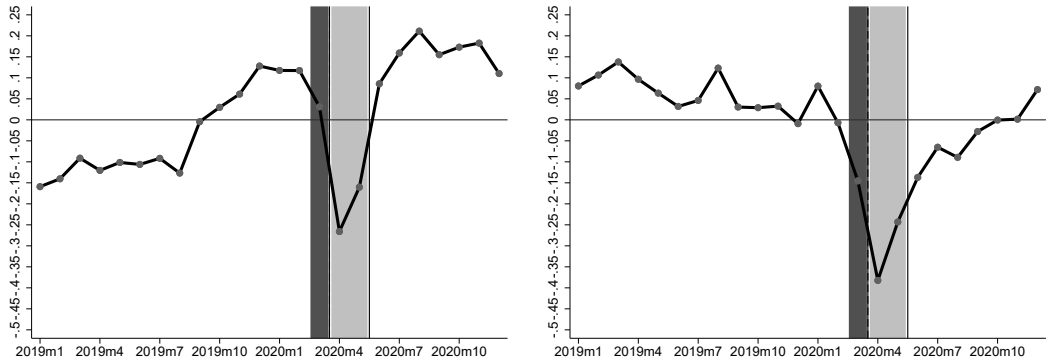


Figure 4. Changes in revenue indexes
This figure presents the average year-on-year changes in monthly domestic and export revenue indexes in industries of tradable sectors from January 2019 until December 2020. Domestic revenue index is adjusted by monthly domestic producer price index while export revenue index is adjusted by monthly non-domestic producer price index.



(a) Domestic (b) Export

Figure 5. Changes in revenue indexes across industries in tradable sectors
This figure shows the variation in the average deflated change in monthly domestic and export revenue indexes in April and May 2020 compared to the same months in 2019 across industries in tradable sectors.

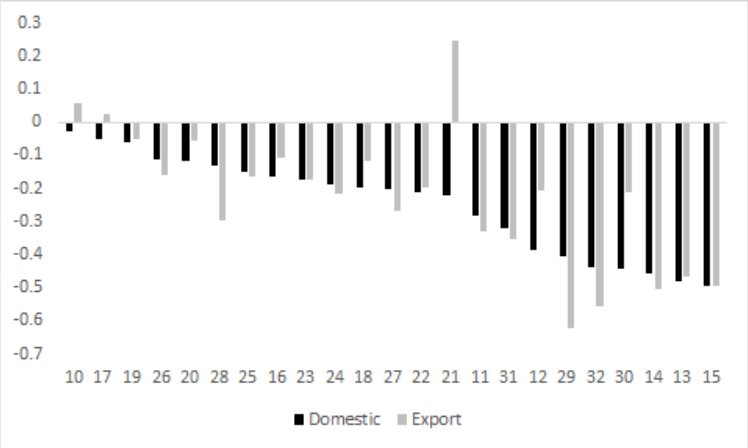


Figure 6. Changes in credit card spending
This figure presents the average year-on-year changes in monthly credit card spending adjusted by monthly consumer price indexes from January 2019 until December 2020.

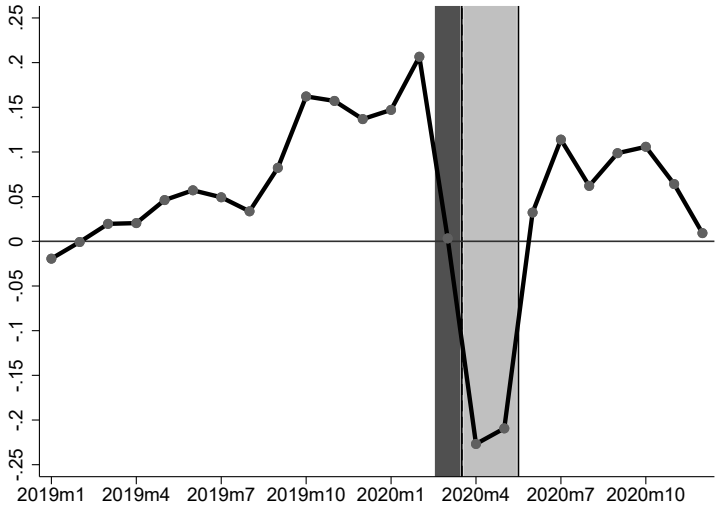


Figure 7. Changes in credit card spending across provinces
This figure shows the variation in the average deflated decline in monthly credit card spending in April and May 2020 compared to the same months in 2019 across provinces in Turkey. Provinces that had an increase in credit spending are set to 0.00% for ease of readability.

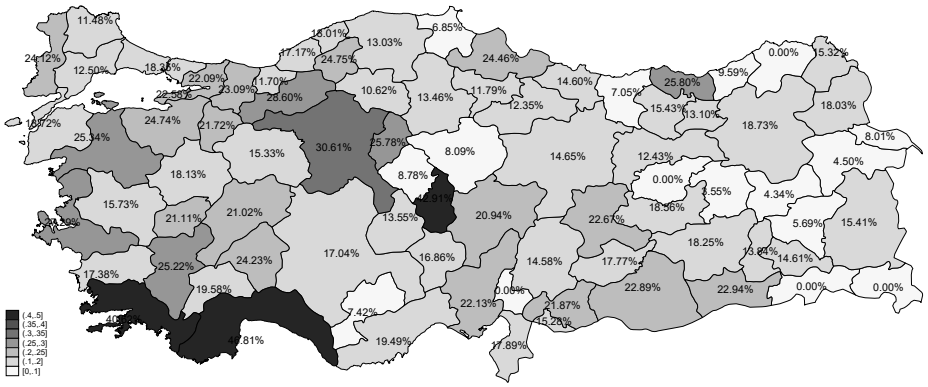


Figure 8. Changes in credit card spending across industries in non-tradable sectors
This figure presents the variation in the average deflated change in monthly credit card spending in April and May 2020 compared to the same months in 2019 across industries in non-tradable sectors.

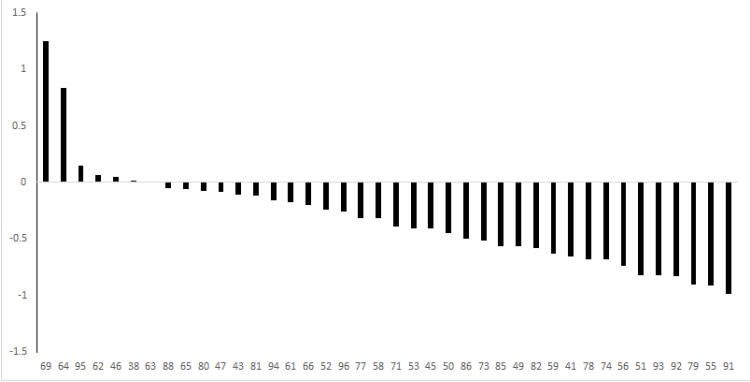


Figure 9. Placebo tests for 2019
This figure presents the coefficient estimates and confidence intervals for estimated effects of exposure in 2019 for months corresponding to our treatment period in 2020. The control period is between January 2018 and February 2019.

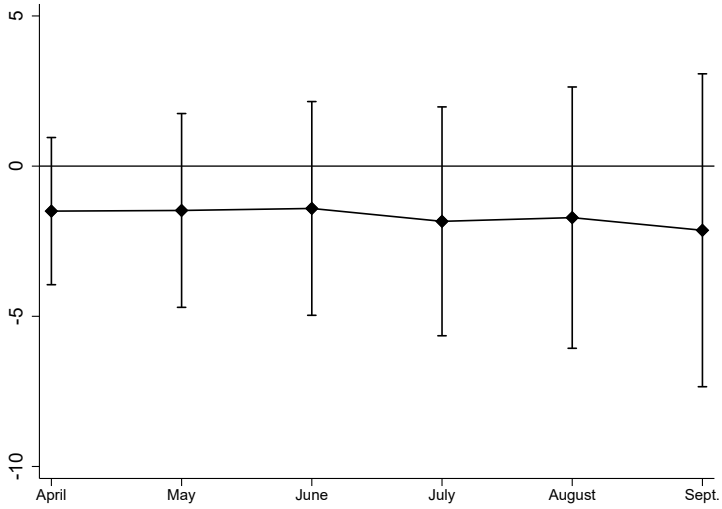


Figure 10. Log change in average volume loans by bank exposure
This figure shows the change in the logarithm of the average volume of loans supplied by banks according to the exposure level. High-exposure banks are those with bank exposure above median at the bank-firm level.

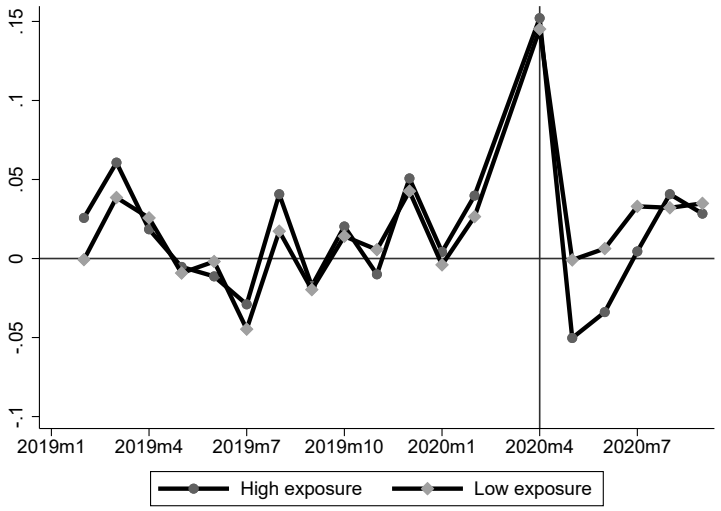
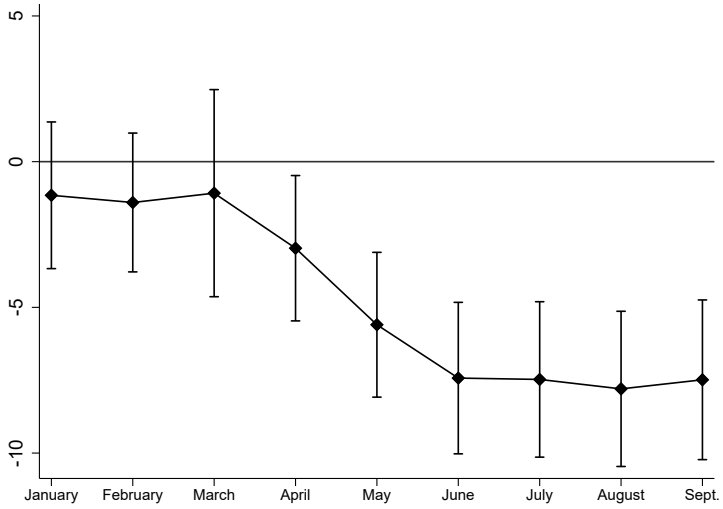


Figure 11. Bank exposure and loans: Coefficient estimates for each month
This figure plots the coefficient estimates of the regressions that examine the monthly effects from January 2020. The identification is similar to equation 5. The monthly coefficients are also reported in column (1) of Table 5.



Tables

Table 1. Summary statistics: Firm-bank level
Each observation is at the firm-bank-month level for the period between January 2019 and September 2020. All loan variables are log transformed. Short-term loans have a maturity of less than a year. Long-term loans have a maturity equal to or longer than a year. *Exposure* measures each bank's exposure to the negative economic shock and is calculated as in equation 3. *Exposure* (*total loans*) is the alternative exposure measure calculated using outstanding total loans at the end of 2019.

	Mean	p50	Std. Dev	p10	p25	p75	p90	N
Pre-treatment								
Total loans	11.373	11.396	2.249	8.616	9.863	12.886	14.136	5,679,017
Short-term loans	10.405	10.308	2.210	7.882	9.164	11.698	13.191	4,859,605
Long-term loans	11.958	12.053	2.021	9.372	10.729	13.122	14.298	3,007,683
Exposure	0.027	0.027	0.012	0.016	0.019	0.030	0.035	5,679,017
Exposure (total loans)	0.129	0.121	0.037	0.097	0.106	0.141	0.166	5,679,017
Post-treatment								
Total loans	11.379	11.400	2.330	8.497	9.866	12.899	14.240	2,319,865
Short-term loans	10.547	10.375	2.346	7.836	9.156	12.012	13.641	1,985,107
Long-term loans	12.033	11.995	1.968	9.868	10.839	13.065	14.323	1,120,053
Exposure	0.026	0.027	0.011	0.016	0.019	0.029	0.035	2,319,865
Exposure (total loans)	0.129	0.121	0.037	0.097	0.106	0.141	0.195	2,319,865

Table 2. Summary statistics: Firm level

Each observation is at the firm-month level for the period between January 2019 and September 2020. The loan variable is log transformed. *Exposure* measures each firm's exposure to the negative economic shock through its banks and is calculated as in equation 7. State-owned share is the ratio of loans from state-owned banks to all loans. Upstream and downstream exposure measure each firm's exposure to the negative economic shock through its supplier and purchaser firms. Upstream exposure is calculated as the weighted-average exposure of industries that the firm's suppliers are operating in, where the weights are the fraction of supplies from each industry. Downstream exposure is calculated similarly as the weighted-average exposure of purchaser industries.

	Mean	p50	Std. Dev.	p10	p25	p75	p90	Obs
Pre-treatment								
Total loans	11.853	11.931	2.509	8.645	9.956	13.593	15.017	3,915,578
Bank exposure	0.025	0.027	0.008	0.017	0.019	0.028	0.032	3,915,578
Number of banks	2.446	2.000	1.872	1.000	1.000	3.000	5.000	3,915,578
State-owned share	0.187	0.000	0.311	0.000	0.000	0.312	0.772	3,915,578
Upstream exposure	0.230	0.199	0.248	-0.037	0.036	0.383	0.575	3,015,372
Downstream exposure	0.148	0.108	0.213	-0.051	-0.003	0.255	0.448	3,015,372
Post-treatment								
Total loans	12.111	12.325	2.650	8.528	10.186	13.951	15.341	1,633,789
Bank exposure	0.026	0.027	0.008	0.017	0.019	0.028	0.032	1,633,789
Number of banks	2.549	2.000	1.890	1.000	1.000	3.000	5.000	1,633,789
State-owned share	0.261	0.000	0.360	0.000	0.000	0.568	0.894	1,633,789
Upstream exposure	0.230	0.199	0.248	-0.037	0.037	0.383	0.574	1,273,386
Downstream exposure	0.148	0.109	0.212	-0.051	-0.003	0.256	0.447	1,273,386

Table 3. Correlation matrix: Exposure and bank characteristics

This table presents the correlation between the exposure measure and several bank characteristics. *Exposure* measures each bank's exposure to the negative economic shock and is calculated as in equation 3. Bank characteristics are calculated using the December 2019 bank balance sheets. Non-performing loans is the ratio of non-performing loans to total loans. Return on equity (ROE) is the ratio of net income to total equity. Liquidity is the ratio of liquid assets to total assets. Non-core funding is the ratio of non-core liabilities to total liabilities. Capital ratio is the ratio of total equity to total assets. Size is the log transformed total assets.

	Exposure	Non-performing loans	Return on equity	Liquidity	Non-core funding	Capital ratio	Size
Exposure	1						
Non-performing loans	-0.0435	1					
Return on equity	-0.037	-0.9078***	1				
Liquidity	0.1934	-0.2068	0.0056	1			
Non-core funding	-0.3009	-0.4616**	0.2065	0.3682*	1		
Capital ratio	-0.2967	-0.3475*	0.1916	0.5061***	0.4346**	1	
Size	0.0091	-0.0232	0.1665	-0.5391***	-0.3516*	-0.5125***	1

*** p<0.01, ** p<0.05, * p<0.1

Table 4. Bank exposure and loans

Panel A presents the coefficient estimates of the regressions that examine the effect of banks' exposure to the negative shock on their loan supply as identified in equation 4. Panel B presents the coefficient estimates of the regressions that examine the monthly effects separately as identified in equation 5. The sample period is from January 2019 to September 2020. The dependent variable is the log of the volume of loans. Short-term loans have a maturity of less than a year. Long-term loans have a maturity equal to or longer than a year. *Exposure* measures each bank's exposure to the negative economic shock and is calculated as in equation 3. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include firm × year-month and bank × firm fixed effects. All standard errors are clustered at the bank × year-month level.

	Total loans (1)	Short-term loans (2)	Long-term loans (3)
A- Main effect			
Post x exposure	-6.42929***	-7.52732***	-8.94413***
	(0.74741)	(0.92541)	(0.88764)
R-squared	0.913	0.870	0.944
N	7,998,882	6,461,979	3,236,316
B- Monthly effects			
April x exposure	-3.70352**	-2.84975**	-8.19529***
	(1.79474)	(1.34877)	(1.85545)
May x exposure	-5.89784***	-5.57519***	-9.04003***
	(1.21049)	(1.49419)	(1.06114)
June x exposure	-7.46207***	-8.66790***	-8.76738***
	(1.14931)	(1.34791)	(1.48603)
July x exposure	-7.40921***	-9.51883***	-8.67894***
	(1.26175)	(1.27889)	(1.56651)
August x exposure	-7.54376***	-9.87282***	-9.17271***
	(1.38666)	(1.24974)	(1.92158)
September x exposure	-7.15358***	-9.63658***	-10.23669***
	(1.34657)	(1.24181)	(2.16601)
R-squared	0.913	0.870	0.944
N	7,998,882	6,461,979	3,236,316

*** p<0.01, ** p<0.05, * p<0.1

Table 5. Bank exposure and loans: Pre and Post monthly estimates
This table presents the coefficient estimates of the regressions that examine the monthly effects from January 2020. The identification is similar to equation 5. The sample period is from January 2019 to September 2020. The dependent variable is the log of the volume of loans. Short-term loans have a maturity of less than a year. Long-term loans have a maturity equal to or longer than a year. *Exposure* measures each bank's exposure to the negative economic shock and is calculated as in equation 3. All columns include firm × year-month and bank × firm fixed effects. All standard errors are clustered at the bank × year-month level.

	Total loans (1)	Short-term loans (2)	Long-term loans (3)
January x exposure	-1.15409	-1.26882	-1.37550
	(1.28387)	(1.14847)	(1.56340)
February x exposure	-1.40141	-0.59712	-3.08549*
	(1.21509)	(1.77453)	(1.58531)
March x exposure	-1.08162	-0.87568	-4.84941***
	(1.81304)	(1.11179)	(1.55983)
April x exposure	-2.97061**	-3.67139***	-5.94595***
	(1.27257)	(0.75732)	(1.68486)
May x exposure	-5.59699***	-6.67498***	-7.49967***
	(1.26743)	(0.98349)	(1.41820)
June x exposure	-7.42690***	-9.87969***	-7.77469***
	(1.32597)	(1.18705)	(1.69599)
July x exposure	-7.47342***	-10.77124***	-7.92874***
	(1.36038)	(1.00168)	(1.76662)
August x exposure	-7.79736***	-11.47641***	-8.53579***
	(1.35879)	(1.11981)	(2.08729)
September x exposure	-7.48544***	-11.28182***	-9.64448***
	(1.39772)	(1.43317)	(2.35363)
R-squared	0.923	0.883	0.948
N	7,998,882	6,461,979	3,236,316

*** p<0.01, ** p<0.05, * p<0.1

Table 6. Bank exposure and loans: Less- versus more-affected industries

The regressions in this table examine the effect of banks' exposure to the negative shock on their loan supply as identified in equation 4 for less- versus more-affected industries separately. Less-affected industries are industries with a shock below median and more-affected are the ones with above median at the firm level. The sample period is from January 2019 to September 2020. The dependent variable is the log of the volume of loans. Short-term loans have a maturity of less than a year. Long-term loans have a maturity equal to or longer than a year. *Exposure* measures each bank's exposure to the negative economic shock and is calculated as in equation 3. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include firm × year-month and bank × firm fixed effects. All standard errors are clustered at the bank × year-month level.

	Less-affected industries			**More-affected industries**		
	Total loans	Short-term loans	Long-term loans	Total loans	Short-term loans	Long-term loans
	(1)	(2)	(3)	(4)	(5)	(6)
Post x exposure	-6.67450***	-7.41333***	-9.87973***	-6.24386***	-7.48094***	-8.62280***
	(0.71450)	(0.97230)	(0.97822)	(0.74711)	(0.87599)	(0.84906)
R-squared	0.903	0.865	0.934	0.915	0.871	0.946
N	3,277,346	3,277,346	3,277,346	2,645,843	2,645,843	2,645,843

*** p<0.01, ** p<0.05, * p<0.1

Table 7. Bank exposure and loans by firm size

The regressions in this table examine the effect of banks' exposure to the negative shock on their loan supply as identified in equation 4 for firms with different sizes with thresholds of 250, 500 and 1000 employees. The sample period is from January 2019 to September 2020. The dependent variable is the log of the volume of loans. *Exposure* measures each bank's exposure to the negative economic shock and is calculated as in equation 3. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include firm × year-month and bank × firm fixed effects. All standard errors are clustered at the bank × year-month level.

	Total loans			
	Employment < 250 (1)	Employment ≥ 250 (2)	Employment ≥ 500 (3)	Employment ≥ 1000 (4)
Post x exposure	-6.73936***	-3.11367***	-3.04048***	-2.50322***
	(0.79145)	(0.49973)	(0.55829)	(0.68268)
R-squared	0.907	0.912	0.870	0.909
N	7,763,268	235,614	180,421	17,475

*** p<0.01, ** p<0.05, * p<0.1

Table 8. Bank exposure and loans: Including single-bank firms
This table presents the regression results that include both multiple- and single-bank firms. Panel A presents the coefficient estimates of the regressions that examine the average effect of banks' exposure to the negative shock on their loan supply. Panel B presents the coefficient estimates of the regressions that examine the monthly effects separately. The sample period is from January 2019 to September 2020. The dependent variable is the log of the volume of loans. Short-term loans have a maturity of less than a year. Long-term loans have a maturity equal to or longer than a year. *Exposure* measures each bank's exposure to the negative economic shock and is calculated as in equation 3. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include industry × province × size × year-month and bank × firm fixed effects. All standard errors are clustered at the bank × year-month level.

	Total loans (1)	Short-term loans (2)	Long-term loans (3)
A- Main effect			
Post x exposure	-5.85488***	-5.44061***	-8.81242***
	(0.85559)	(0.91727)	(1.11712)
R-squared	0.859	0.783	0.908
N	11,211,587	9,574,923	5,446,937
B- Monthly effects			
April x exposure	-2.81539	-1.34764	-7.28028***
	(1.82595)	(1.00363)	(2.24223)
May x exposure	-5.04366***	-3.03895**	-8.98253***
	(1.23147)	(1.39495)	(1.28766)
June x exposure	-6.80465***	-6.13297***	-9.03907***
	(1.32195)	(1.45303)	(1.75238)
July x exposure	-7.10211***	-7.67704***	-8.86638***
	(1.52372)	(1.59808)	(1.83757)
August x exposure	-7.08463***	-7.64706***	-9.20893***
	(1.62751)	(1.46800)	(2.14493)
September x exposure	-6.85827***	-7.59872***	-10.00232***
	(1.66276)	(1.43668)	(2.41225)
R-squared	0.859	0.783	0.908
N	11,211,587	9,574,923	5,446,937

*** p<0.01, ** p<0.05, * p<0.1

Table 9. Bank exposure and loans: bank controls

The regressions in this table examine the effect of banks' exposure to the negative shock on their loan supply by including bank characteristics as additional controls to the identification in equation 4 . The sample period is from January 2019 to September 2020. The dependent variable is the log of the volume of loans. *Exposure* measures each bank's exposure to the negative economic shock and is calculated as in equation 3. *Post* dummy indicates the post-pandemic period between April and September 2020. Bank characteristics are calculated using the December 2019 bank balance sheets. Non-performing loans is the ratio of non-performing loans to total loans. Return on equity (ROE) is the ratio of net income to total equity. Liquidity is the ratio of liquid assets to total assets. Non-core funding is the ratio of non-core liabilities to total liabilities. Capital ratio is the ratio of total equity to total assets. Size is the log transformed total assets. All columns include firm × year-month and bank × firm fixed effects. All standard errors are clustered at the bank × year-month level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post x exposure	-6.43036***	-6.51389***	-6.66139***	-6.54638***	-6.37077***	-6.17656***	-5.14874***
	(0.74548)	(0.74934)	(0.66400)	(0.79495)	(0.66359)	(1.06193)	(0.97616)
Post x non-performing loans	0.20581						-0.67819
	(0.57071)						(0.82724)
Post x ROE		0.10795**					-0.04153
		(0.04539)					(0.09243)
Post x liquidity			-1.56836***				-1.98744***
			(0.18855)				(0.21566)
Post x non-core funding				-0.18101			0.33963*
				(0.16900)			(0.19305)
Post x capital ratio					0.11185		0.92489**
					(0.47225)		(0.42120)
Post x size						0.00602	0.01990
						(0.01613)	(0.01748)
R-squared	0.913	0.913	0.913	0.913	0.913	0.913	0.913
N	7,998,882	7,998,882	7,998,882	7,998,882	7,998,882	7,998,882	7,998,882

*** p<0.01, ** p<0.05, * p<0.1

Table 10. Bank exposure and loans by bank liquidity

The regressions in this table examine the effect of banks' exposure to the negative shock on their loan supply as identified in equation 4 for low- and high-liquidity banks separately. The sample period is from January 2019 to September 2020. The dependent variable is the log of the volume of loans. *Exposure* measures each bank's exposure to the negative economic shock and is calculated as in equation 3. *Post* dummy indicates the post-pandemic period between April and September 2020. High liquidity banks are those with a liquidity above the (bank-level) median in December 2019. All columns include firm × year-month and bank × firm fixed effects. All standard errors are clustered at the bank × year-month level.

	Low-liquidity banks			**High-liquidity banks**		
	Total loans	Short-term loans	Long-term loans	Total loans	Short-term loans	Long-term loans
	(1)	(2)	(3)	(4)	(5)	(6)
Post x exposure	-8.67332***	-10.02142***	-11.27132***	-4.90957***	-3.38972***	-6.44543***
	(0.94128)	(0.97197)	(1.10683)	(0.71248)	(1.23644)	(1.28862)
R-squared	0.954	0.933	0.972	0.913	0.874	0.942
N	6,618,314	5,339,661	2,631,647	168,104	80,054	76,637

*** p<0.01, ** p<0.05, * p<0.1

Table 11. Firm-level effects

Panel A presents the coefficient estimates of the regressions that examine the effect of firms' exposure to the negative shock on their total loans as identified in equation 6. Panel B presents the coefficient estimates of the regressions that examine the monthly effects separately as identified in equation 8. The sample period is from January 2019 to September 2020. Total loans is the log of the volume of total loans at the firm level. Bank exposure is the firm's time varying exposure to the negative shock of its banks. Number of banks is the number of banks that each firm borrows from. State-owned share is the ratio of loans from state-owned banks to all loans. *Exposure* measures each firm's exposure to the negative economic shock through its banks and is calculated as in equation 7. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include industry × province × year-month and firm fixed effects. All standard errors are clustered at the firm level.

	Total loans	Bank exposure	Number of banks	State-owned share
	(1)	(2)	(3)	(4)
A- Main effect				
Post x exposure	-3.84251***	-0.06805***	-1.77516***	0.16367***
	(0.30315)	(0.00391)	(0.21662)	(0.05008)
R-squared	0.899	0.889	0.920	0.826
N	5,549,367	5,549,367	5,549,367	5,549,367
B- Monthly effects				
April x exposure	-1.40784***	-0.01092***	-1.31427***	0.25999***
	(0.30325)	(0.00288)	(0.20355)	(0.04706)
May x exposure	-2.88282***	-0.04352***	-1.45548***	0.19783***
	(0.33849)	(0.00394)	(0.21955)	(0.05182)
June x exposure	-4.33092***	-0.07036***	-1.64166***	0.17653***
	(0.33653)	(0.00418)	(0.23412)	(0.05411)
July x exposure	-4.84365***	-0.08703***	-2.01625***	0.13821**
	(0.34527)	(0.00497)	(0.23990)	(0.05548)
August x exposure	-4.78704***	-0.09603***	-2.02324***	0.12058**
	(0.35277)	(0.00511)	(0.24915)	(0.05663)
September x exposure	-4.91509***	-0.10355***	-2.23281***	0.08314
	(0.35841)	(0.00507)	(0.26065)	(0.05730)
R-squared	0.899	0.889	0.920	0.826
N	5,549,367	5,549,367	5,549,367	5,549,367

*** p<0.01, ** p<0.05, * p<0.1

Table 12. Firm-level effects by state-owned bank relationship

Table presents the coefficient estimates of the regressions that examine the effect of firms' exposure to the negative shock on their total loans as identified in equation 6. Firms are divided into two as firms with a state-owned bank relationship that had a positive amount of loans from state-owned banks at the end of 2019 and firms with no state-owned relationship that had loans only from privately-owned banks. The sample period is from January 2019 to September 2020. Total loans is the log of the volume of total loans at the firm level. Bank exposure is the firm's time varying exposure to the negative shock of its banks. Number of banks is the number of banks that each firm borrows from. State-owned share is the ratio of loans from state-owned banks to all loans. *Exposure* measures each firm's exposure to the negative economic shock through its banks and is calculated as in equation 7. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include industry × province × year-month and firm fixed effects. All standard errors are clustered at the firm level.

	Without state-owned bank relationship				**With state-owned bank relationship**			
	Total loans	Bank exposure	Number of banks	State-owned share	Total loans	Bank exposure	Number of banks	State-owned share
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post x exposure	-4.81021***	-0.05220***	-0.70027***	-0.09137*	-2.81100***	-0.09716***	-3.20009***	0.46799***
	(0.41575)	(0.00432)	(0.21013)	(0.05413)	(0.39893)	(0.00777)	(0.48500)	(0.10247)
R-squared	0.847	0.904	0.919	0.409	0.903	0.825	0.900	0.727
N	3,540,952	3,540,952	3,540,952	3,540,952	1,990,869	1,990,869	1,990,869	1,990,869

*** p<0.01, ** p<0.05, * p<0.1

Table 13. Firm-level effects: Less- versus more-affected industries

The regressions in this table examine the effect of firms' exposure to the negative shock on their total loans as identified in equation 6 for less- versus more-affected industries separately. Less-affected industries are industries with a shock below median and more-affected are the ones with above median. The sample period is from January 2019 to September 2020. Total loans is the log of the volume of total loans at the firm level. Bank exposure is the firm's time varying exposure to the negative shock of its banks. Number of banks is the number of banks that each firm borrows from. State-owned share is the ratio of loans from state-owned banks to all loans. *Exposure* measures each firm's exposure to the negative economic shock through its banks and is calculated as in equation 7. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include industry × province × year-month and firm fixed effects. All standard errors are clustered at the firm level.

	Less-affected industries				**More-affected industries**			
	Total loans	Bank exposure	Number of banks	State-owned share	Total loans	Bank exposure	Number of banks	State-owned share
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post x exposure	-4.13593***	-0.07474***	-1.40268***	0.17505**	-3.61572***	-0.09562***	-2.15948***	0.28156***
	(0.51824)	(0.00609)	(0.36960)	(0.08019)	(0.48439)	(0.01252)	(0.38424)	(0.09071)
R-squared	0.898	0.858	0.922	0.924	0.791	0.876	0.920	0.821
N	2,086,085	2,086,085	2,086,085	2,086,085	2,067,175	2,067,175	2,067,175	2,067,175

*** p<0.01, ** p<0.05, * p<0.1

Table 14. Firm-level effects by firm size

The regressions in this table examine the effect of firms' exposure to the negative shock on their total loans as identified in equation 6 for firms with different sizes with thresholds of 250, 500 and 1000 employees. The sample period is from January 2019 to September 2020. Total loans is the log of the volume of total loans at the firm level. *Exposure* measures each firm's exposure to the negative economic shock through its banks and is calculated as in equation 7. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include industry × province × year-month and firm fixed effects. All standard errors are clustered at the firm level.

	Total loans			
	Employment < 250 (1)	Employment ≥ 250 (2)	Employment ≥ 500 (3)	Employment ≥ 1000 (4)
Post x exposure	-3.90016***	-4.67089***	-2.69234	-2.10404
	(0.30860)	(1.75140)	(2.95507)	(2.99810)
R-squared	0.895	0.805	0.908	0.907
N	5,470,850	71,126	27,680	10,717

*** p<0.01, ** p<0.05, * p<0.1

Table 15. Firm level effects: all exposures

This table presents the coefficient estimates of the regressions that examine the effect of firms' exposure to the negative shock on their total loans as identified in equation 6. The sample period is from January 2019 to September 2020. Total loans is the log of the volume of total loans at the firm level. Bank exposure is the firm's time varying exposure to the negative shock of its banks. Number of banks is the number of banks that each firm borrows from. State-owned share is the ratio of loans from state-owned banks to all loans. *Exposure* measures each firm's exposure to the negative economic shock through its banks and is calculated as in equation 7. Upstream and downstream exposure measure each firm's exposure to the negative economic shock through its supplier and purchaser firms. Upstream exposure is calculated as the weighted-average exposure of industries that the firm's suppliers are operating in, where the weights are the fraction of supplies from each industry. Downstream exposure is calculated similarly as the weighted-average exposure of purchaser industries. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include industry × province × year-month and firm fixed effects. All standard errors are clustered at the firm level.

	Total loans	Bank exposure	Number of banks	State-owned share
	(1)	(2)	(3)	(4)
Post x bank exposure	-4.19192***	-0.10220***	-1.98946***	0.22351***
	(0.35543)	(0.01289)	(0.26753)	(0.06033)
Post x upstream exposure	-0.00235	-0.00025	0.01831**	-0.00127
	(0.01470)	(0.00017)	(0.00921)	(0.00225)
Post x downstream exposure	-0.01404	0.00026*	0.00239	-0.00134
	(0.01162)	(0.00014)	(0.00775)	(0.00225)
R-squared	0.897	0.881	0.919	0.822
N	4,288,758	4,288,758	4,288,758	4,288,758

*** p<0.01, ** p<0.05, * p<0.1

Table 16. Firm level effects: Firms with multiple borrowers
Panel A presents the coefficient estimates of the regressions that examine the effect of firms' exposure to the negative shock on their total loans as identified in equation 6. Panel B presents the coefficient estimates of the regressions that examine the monthly effects separately as identified in equation 8. The sample period is from January 2019 to September 2020 and the sample consists of firms with loans from at least two privately-owned banks at the end of 2019. Total loans is the log of the volume of total loans at the firm level. Bank exposure is the firm's time varying exposure to the negative shock of its banks. Number of banks is the number of banks that each firm borrows from. State-owned share is the ratio of loans from state-owned banks to all loans. *Exposure* measures each firm's exposure to the negative economic shock through its banks and is calculated as in equation 7. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include industry × province × year-month and firm fixed effects. All standard errors are clustered at the firm level.

	Total loans	Bank exposure	Number of banks	State-owned share
	(1)	(2)	(3)	(4)
A- Main effect				
Post x exposure	-2.06907***	-0.09648***	-2.13336***	0.10484
	(0.30808)	(0.00622)	(0.38664)	(0.07729)
R-squared	0.935	0.848	0.909	0.841
N	2,610,155	2,610,155	2,610,155	2,610,155
B- Monthly effects				
April x exposure	-0.46895	-0.02376***	-1.26725***	0.24493***
	(0.29475)	(0.00452)	(0.36406)	(0.07464)
May x exposure	-1.54490***	-0.06683***	-1.78377***	0.13689*
	(0.32673)	(0.00642)	(0.39908)	(0.08074)
June x exposure	-2.42138***	-0.10262***	-1.84741***	0.11788
	(0.34039)	(0.00703)	(0.41306)	(0.08328)
July x exposure	-2.85176***	-0.12268***	-2.60438***	0.06358
	(0.36009)	(0.00818)	(0.43250)	(0.08613)
August x exposure	-2.53037***	-0.13198***	-2.56904***	0.04549
	(0.36366)	(0.00758)	(0.44638)	(0.08711)
September x exposure	-2.71282***	-0.13735***	-2.81911***	0.00813
	(0.36793)	(0.00772)	(0.47373)	(0.08762)
R-squared	0.935	0.848	0.909	0.841
N	2,610,155	2,610,155	2,610,155	2,610,155

*** p<0.01, ** p<0.05, * p<0.1

Table 17. Firm level effects: Sales

Table presents the coefficient estimates of the regressions that examine the quarterly effects on firm sales separately, similar to equation 8. The sample period consists of three quarters of 2020. The dependent variable is the log of sales. *Exposure* measures each firm's exposure to the negative economic shock through its banks and is calculated as in equation 7. *Industry exposure* is the exposure of each firm's industry to the shock as calculated in equations 1 and 2. Q2 and Q3 indicate the second and third quarter of 2020. All columns include firm and year-month fixed effects. All standard errors are clustered at the firm level.

	All	Tradable industries	Non-tradable industries
	(1)	(2)	(3)
Q2 x industry exposure	-0.72816***	-0.83989***	-0.72757***
	(0.00890)	(0.02680)	(0.00943)
Q3 x industry exposure	-0.12301***	-0.03103	-0.13033***
	(0.00878)	(0.02467)	(0.00935)
Q2 x exposure	-0.89483***	0.10173	-1.54909***
	(0.27749)	(0.46102)	(0.34408)
Q3 x exposure	-0.82129***	-1.03885**	-0.76715**
	(0.28178)	(0.47216)	(0.34855)
R-squared	0.921	0.915	0.945
N	575,151	145,897	429,254

*** p<0.01, ** p<0.05, * p<0.1

Internet Appendix

Table A1. Bank exposure and loans: alternative measures
This table presents the coefficient estimates of the regressions that examine the effect of banks' exposure to the negative shock on their loan supply with two exposure measures. *Exposure* is the baseline exposure measure based on banks' short term loans with a maturity of less than year. *Exposure* (*total loans*) is the alternative exposure measure calculated using outstanding total loans at the end of 2019. The sample period is from January 2019 to September 2020. The dependent variable is the log of the volume of loans. Short-term loans have a maturity of less than a year. Long-term loans have a maturity equal to or longer than a year. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include firm × year-month and bank × firm fixed effects. All standard errors are clustered at the bank × year-month level.

	Total loans (1)	Short-term loans (2)	Long-term loans (3)
Post x exposure (total loans)	-0.15756	-0.11407	0.96713***
	(0.29312)	(0.29618)	(0.33005)
Post x exposure	-6.27986***	-7.40621***	-9.73857***
	(0.81157)	(0.92049)	(0.90443)
R-squared	0.913	0.870	0.944
N	7,998,882	6,461,979	3,236,316

*** p<0.01, ** p<0.05, * p<0.1

Table A2. Alternative bank exposure and loans
This table presents the results with the alternative exposure measure that is calculated with outstanding total loans at the end of 2019. Panel A presents the coefficient estimates of the regressions that examine the effect of banks' exposure to the negative shock on their loan supply as identified in equation 4. Panel B presents the coefficient estimates of the regressions that examine the monthly effects separately as identified in equation 5. The sample period is from January 2019 to September 2020. The dependent variable is the log of the volume of loans. Short-term loans have a maturity of less than a year. Long-term loans have a maturity equal to or longer than a year. *Exposure* measures each bank's exposure to the negative economic shock when all its loans are taken into account. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include firm × year-month and bank × firm fixed effects. All standard errors are clustered at the bank × year-month level.

	Total loans (1)	Short-term loans (2)	Long-term loans (3)
A- Main effect			
Post x exposure	-0.74404**	-0.89636***	0.20660
	(0.31178)	(0.32648)	(0.39227)
R-squared	0.912	0.870	0.944
N	7,998,882	6,461,979	3,236,316
B- Monthly effects			
April x exposure	-1.61016***	-0.58273	-1.42678***
	(0.45996)	(0.42200)	(0.51104)
May x exposure	-0.63789	-1.12506**	0.15768
	(0.52589)	(0.49457)	(0.62676)
June x exposure	-0.50185	-1.32528**	0.61159
	(0.61783)	(0.58580)	(0.64101)
July x exposure	-0.51858	-0.75656	0.58515
	(0.63071)	(0.72715)	(0.63369)
August x exposure	-0.58375	-0.87185	0.76458
	(0.63831)	(0.67224)	(0.72990)
September x exposure	-0.51873	-0.72672	0.98709
	(0.62416)	(0.67692)	(0.85825)
R-squared	0.912	0.870	0.944
N	7,998,882	6,461,979	3,236,316

*** p<0.01, ** p<0.05, * p<0.1

Table A3. Firm-level effects of the alternative exposure measure
This table presents the firm-level results with the alternative exposure measure that is calculated with outstanding total loans at the end of 2019. Panel A presents the coefficient estimates of the regressions that examine the effect of firms' exposure to the negative shock on their total loans as identified in equation 6. Panel B presents the coefficient estimates of the regressions that examine the monthly effects separately as identified in equation 8. The sample period is from January 2019 to September 2020. Loans is the log of the volume of all loans at the firm level. Bank exposure is the firm's time varying exposure to the negative shock of its banks. Number of banks is the number of banks that each firm borrows from. State-owned share is the ratio of loans from state-owned banks to all loans. *Exposure* measures each firm's exposure to the negative economic shock through its banks and is calculated as in equation 7. *Post* dummy indicates the post-pandemic period between April and September 2020. All columns include industry × province × year-month and firm fixed effects. All standard errors are clustered at the firm level.

	Total loans	Bank exposure	Number of banks	State-owned share
	(1)	(2)	(3)	(4)
A- Main effect				
Post x exposure	-1.06362***	-0.03935***	-0.66362***	-0.00334
	(0.09444)	(0.00425)	(0.05219)	(0.01312)
R-squared	0.899	0.889	0.920	0.826
N	5,549,367	5,549,367	5,549,367	5,549,367
B- Monthly effects				
April x exposure	-1.31836***	0.00325	-0.35685***	0.01849
	(0.09690)	(0.00408)	(0.04852)	(0.01231)
May x exposure	-1.01565***	-0.02231***	-0.60679***	-0.01993
	(0.11210)	(0.00491)	(0.05280)	(0.01356)
June x exposure	-0.91562***	-0.04155***	-0.73350***	-0.01021
	(0.10613)	(0.00466)	(0.05675)	(0.01434)
July x exposure	-0.96930***	-0.05362***	-0.79009***	-0.00893
	(0.10739)	(0.00524)	(0.05861)	(0.01469)
August x exposure	-1.07842***	-0.05947***	-0.74697***	0.00300
	(0.10896)	(0.00502)	(0.06022)	(0.01506)
September x exposure	-1.08124***	-0.06433***	-0.75757***	-0.00255
	(0.10856)	(0.00476)	(0.06509)	(0.01518)
R-squared	0.899	0.889	0.920	0.826
N	5,549,367	5,549,367	5,549,367	5,549,367

*** p<0.01, ** p<0.05, * p<0.1