Lending relationships and a corporate liquidity shortage: Evidence from the COVID-19 shock in Japan

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We investigate the effects of lending relationships between banks and borrowers on loan supply during the economic shock caused by the coronavirus (COVID-19) pandemic. Using bank–firm matched data for Japan to control for several firm- and bank-specific unobserved effects, we show that banks with close relationships with borrowing firms offer more bank loans to these firms during the COVID-19 shock. This effect is larger if the borrowing firms’ cash flows decrease substantially during the shock. These results imply that banks acted as liquidity providers for borrowers during sudden and unpredictable shocks if their relationships with firms were close.

JEL CLASSIFICATION
G21, G32, G20

1 INTRODUCTION

We investigate the effects of lending relationships between banks and firms on the provision of loans for a sudden and unpredictable liquidity shock. To do this, we consider the liquidity shock caused by the coronavirus (COVID-19) pandemic using bank–firm matched data for Japan. The COVID-19 pandemic worsened the business conditions of Japanese firms in the first quarter of 2020. For example, the Short-Term Economic Survey of Enterprises in Japan, conducted by the Bank of Japan (Tankan in Japanese), reveals a diffusion index (DI) of business conditions value of 8 in September 2019 and 4 in December 2019, but it dropped to -4 in March 2020 and -31 in June 2020.1 This suggests that business conditions have suddenly declined. Simultaneously, demand for bank loans increased. The Senior Loan Officer Opinion Survey (LOOS) on bank lending practices at large Japanese banks (conducted by the Bank of Japan) shows that the main causes of increases in bank loan demand following the shock were cash shortages and increases in cash reserves.2 This implies that firms needed bank loans due to liquidity shortages caused by shocks. We investigate which banks offer bank loans.

The literature on relationship lending claims that banks having close relationships with borrowing firms offer more loans to these firms during a shock period. As Petersen and Rajan (1994) and Berger and Udell (1995) argued, the close relationships between banks and firms enhance the credit availability of borrowers, which is called relationship lending (or banking). Especially during a shock period, firms that have a close lending relationship with a bank enjoy the benefits. As noted by Berlin and Mester (1999) and Boot (2000), through intertemporal smoothing of loan interest rates, banks can offer credit to firms with lending relationships during a shock period. Therefore, if firms have sudden credit needs to finance liquidity shortages caused by an economic shock, they offer more loans to firms, which is an insurance hypothesis. By contrast, previous studies imply that banks do not offer loans because of liquidity shortages if they do not have close relationships with borrowing firms.

Previous empirical studies on relationship lending (e.g., Cotugno et al., 2013; Dewally & Shao, 2014; Gobbi & Sette, 2014; Jiangli et al., 2008) show that firms with strong relationships with banks can use bank loans during financial crises. For example, using Italian data, Cotugno et al. (2013) showed that a strong lender–borrower relationship mitigates credit rationing for borrowing firms during a credit crunch period. However, many previous studies mainly used firm-level panel data rather than bank–firm matched panel data. In addition, because these studies investigated the effects of lenders’ loan supply shocks caused by past financial crises (e.g., the global financial crisis after 2008), few studies have focused on borrowers’ cash flow shocks during an economic (but nonfinancial) crisis. This hypothesis is applied to the economic shock caused by COVID-19 because it occurred suddenly and unpredictably. Furthermore, given that the banking sector
did not suffer seriously from this shock, we can test the insurance hypothesis more accurately by focusing on the shock caused by COVID-19.

We investigate these hypotheses using bank–firm matched data for Japan. To investigate whether banks offer loans because of liquidity shortages, we must identify the bank-specific supply of loans for a specific firm. Using firm-level data, we cannot identify which banks offer more loans during the shock period. Furthermore, the changes in the amount of firm-level loans are reflected in the aggregate demand and supply of loans. During the shock period, the demand for loans for financing investment opportunities might be low, while the need for financing liquidity shortages is high. As argued by Khwaja and Mian (2008), the identification problem is mitigated using matched data. We can control firm-specific and aggregate loan demand shocks using firm, year, and firm × year fixed effects because we can use multiple observations for the same year and firm. For the same reason, we can control for unobserved bank characteristics using bank and bank × year fixed effects. After controlling for these fixed effects, we can extract the effects of the specific relationship between firms and banks on loan provisions during the shock period.

Japanese data for 2018–2021 (which includes before and during the shock period) show that banks offered more loans to firms the COVID-19 pandemic shock if the banks’ lending share among borrowing firms was the largest. In addition, if firms experienced a decline in cash flow during the shock, banks with the largest lending share offered more loans compared with other banks. These effects are larger in 2020, which is the beginning of the COVID-19 pandemic. As Kang and Stulz (2000) noted, banks with the largest share have close relationships with borrowing firms. We interpret these results as suggesting that close relationships between banks and firms enhanced credit supply for firms experiencing a liquidity shock during the COVID-19 shock, which supports the insurance hypothesis.

Our main contributions are as follows. First, we test whether banks offer loans to firms that experienced sudden liquidity shocks using bank–firm matched data. Previous studies (e.g., Khwaja & Mian, 2008) investigated the effects of bank liquidity shocks (lender shocks) using bank–firm matched data. However, few studies have investigated the effects of firm liquidity shocks (borrowers’ shocks) using matched data. Second, because past shocks (e.g., the global financial crisis after 2008) damaged the financial sector, we have to control for the negative effects on loan supply. By focusing on the COVID-19 shock, we can test the insurance hypothesis more accurately because the financial sector was not seriously damaged. The negative effects on loan supply are insignificant, allowing us to extract the effects of lending relationships. Third, we test the insurance hypothesis by focusing on the ongoing economic crisis, after 2020, caused by COVID-19. This sudden and serious shock impeded economic activity in many countries. To investigate which banks offered loans in response to the liquidity shock caused by the pandemic, we examine the role of banks in mitigating the negative effects of the sudden shock.

The remainder of this paper is organized as follows. In Section 2, we introduce our empirical strategy to investigate the effects of lending relationships during a shock. The estimation results are presented and discussed in Section 3. Finally, Section 4 concludes the paper.

## 2 | ESTIMATION STRATEGY

If banks that have close relationships with borrowers were liquidity providers during the shock period, they would have offered more loans to firms than banks that did not have close relationships. To investigate this, we estimated the following equation:

\[
\text{Bank Borrowings}_{i,j,t} = \beta_1 \text{Bank Ranking}^{r}_{i,t-1} + \beta_2 \text{Bank Ranking}^{r}_{i,t-1} \times \text{Shock}_{t} + \epsilon_{i,j,t} \quad (1)
\]

where bank borrowings from bank \( j \) (normalized by a firm’s total assets) is a dependent variable for firm \( i \) in March of year \( t \); \( \text{Bank Ranking}^{r}_{i,t-1} \) is a proxy of the strength of the relationship between firm \( i \) and bank \( j \) in year \( t-1 \); \( \text{Shock}_{t} \) is a dummy variable that equals 1 if the year is 2020 or 2021; \( \epsilon_{i,j,t} \) is firm fixed effects for firm \( i \); \( \zeta_j \) is bank fixed effects for bank \( j \); \( \eta_t \) is year fixed effects for year \( t \); and \( \theta_{ij,t} \) is the error term of firm \( i \) in year \( t \), with \( t \) ranging from 2018 to 2021. We use total, short-term, and long-term borrowings normalized by a firm’s total assets as the dependent variable.

We employ data from 2018 to 2021 for 1422 nonfinancial Japanese firms from the Nikkei Financial Quest database. We obtain data on short-term, long-term, and total borrowings by firm \( i \) from bank \( j \) in year \( t \). This database contains borrowing data for firms \( i \) from bank \( j \) if the total borrowings from bank \( j \) are not zero. We also use data on financial statements for firm \( i \) and match these financial data with the bank borrowing data. The total number of firm–bank–year observations is 24,844.

We use bank rankings (bank ranking\(^1\), bank ranking\(^2\), and bank ranking\(^3\)) as proxies for the strength of relationships. \( \text{Bank Ranking}^{r}_{i,t-1} \) is a dummy variable that equals 1 if bank \( j \)’s lending share for firm \( i \) in year \( t-1 \) is the highest \(( r = 1) \), second highest \(( r = 2) \), or third highest \(( r = 3) \). We assume that the relationships are closer if the lending share rank is higher. Kang and Stulz (2000) defined the bank with the largest lending share as the main bank, which has a close relationship with the firm. Therefore, our definition of relationships is similar to that of Kang and Stulz (2000). We limit bank \( j \) to private banks.

By definition of \( \text{Bank Ranking}^{r}_{i,j,t-1} \), the predicted signs of \( \text{Bank Ranking}^{r}_{i,j,t-1} \) are positive, and \( \beta_1 > \beta_2 > \beta_3 \) holds. The coefficients of \( \text{Bank Ranking}^{r}_{i,j,t-1} \times \text{Shock}_{t} \) show by how much the top-, second-, and third-ranked banks increased bank loans for firm \( i \) during the COVID-19 shock period, compared with the other banks. If banks with close relationships with borrowing firms increase loans to these firms during the shock period, then \( \beta_2 \) is positive and \( \beta_2 > \beta_3 > \beta_1 \) holds.

Bank borrowings are affected by aggregate demand and supply of loans. During the shock period, the demand for loans is affected by low investment opportunities, while the need for financing liquidity
shortages is high. To control these effects, Equation (1) includes several fixed effects. \( e_i \) captures unobserved firm fixed effects, \( \eta_t \) captures unobserved bank fixed effects, and \( \eta_j \) captures unobserved year fixed effects. Bank fixed effects \( \{\eta_j\} \) include unobserved bank characteristics, which are proxies for banks’ aggregate supply of loans. We control for firm \( \times \) year fixed effects by including \( e_i \times \eta_t \), which controls firm-specific loan demand shocks both before and during the shock period. These effects also control the credit risk of firm \( i \) in year \( t \). As we use bank–firm matched data, we can control firm \( \times \) year fixed effects in Equation (1) because we can use multiple observations for the same year and firm. In addition, we control for bank \( \times \) year fixed effects by including \( \eta_j \times \eta_t \), which controls bank-specific loan supply shocks both before and during the shock period. By controlling for several fixed effects, we can extract the bank–firm relationship-specific effects on bank borrowings from each bank during the shock period.

Equation (1) includes firm \( \times \) year fixed effects, which control firm \( i \)’s characteristics, financial conditions, and credit risk (e.g., firm size, leverage, and profitability). To check the robustness of the results, we also estimate Equation (1) including a vector of control variables (firm’s size, cash flow, leverage, cash holding ratio, and tangibility) instead of \( e_i \times \eta_t \). Size is the natural logarithm of the total assets in year \( t - 1 \). Leverage is the ratio of a firm’s total debt to total assets in year \( t - 1 \). Cash flow is the ratio of a firm’s earnings before interest, taxes, depreciation, and amortization (EBITDA) to total assets during year \( t \). Cash holding ratio is the ratio of a firm’s cash holdings to total assets in year \( t - 1 \). Tangibility is the ratio of a firm’s fixed tangible assets to the total assets in year \( t - 1 \).

To identify the individual liquidity shocks of each firm, we also focus on the cash flow crisis proxied by EBITDA (used by Brown et al., 2021). We estimated the following equation:

\[
\text{Bank Borrowings}_{i,j,t} = \sum_{r=1,2,3} \gamma^r_{1} \text{Bank Ranking}_{i,j,t-1}^r + \sum_{r=1,2,3} \gamma^r_{2} \text{Bank Ranking}_{i,j,t-1}^r \times \text{Shock}_t + \sum_{r=1,2,3} \gamma^r_{3} \text{Bank Ranking}_{i,j,t-1}^r \times \text{Cash Flow}_{i,t} + \sum_{r=1,2,3} \gamma^r_{4} \text{Bank Ranking}_{i,j,t-1}^r \times \text{Cash Flow}_{i,t} \times \text{Shock}_t + e_i + \eta_t + e_i \times \eta_t + \eta_j + \theta_{i,j,t},
\]

(2)

where bank borrowings from bank \( j \) are dependent variables for firm \( i \) in year \( t \). The definitions of each variable are the same as those in Equation (1).

As described, we predict that \( \gamma^1_1 > 0, \gamma^1_2 > \gamma^2_2 > \gamma^3_2, \) and \( \gamma^2_1 > 0 \). If banks with close relationships with borrowing firms offer more bank loans to these firms experiencing a decline in cash flow, the coefficients of \( \text{Bank Ranking}_{i,j,t-1}^1 \times \text{Cash Flow}_{i,t} \) are negative. In addition, if these banks increased bank loans to firms with cash flow declines during the COVID-19 shock period, the coefficients of \( \text{Bank Ranking}_{i,j,t-1} \times \text{Cash Flow}_{i,t} \times \text{Shock}_t \) are negative. If this holds, we interpret that banks that have close relationships with firms act as liquidity providers during the COVID-19 shock. In all equations, we estimate the standard errors based on clustering across firms and banks.

3 | ESTIMATION RESULTS

3.1 | Estimation results for Equation (1)

Table 1 shows the summary statistics for the dependent and independent variables used in the econometric analysis. Table 2 presents the estimation results for Equation (1). Column (1) shows the results using total bank borrowings from bank \( j \). Column (2) shows those using short-term borrowings, and Column (3) shows those using long-term borrowings as dependent variables.

In all columns, the estimated coefficients of bank ranking are positive and statistically significant at the 1% level. Focusing on coefficient size, we see that \( \beta^1_1 > \beta^2_2 > \beta^3_2 \) is supported. In Column (1), the estimated coefficient of bank ranking \( ^1 \times \text{shock} \) is positive and statistically significant at the 5% level. Firms increased total bank borrowings by 0.439 percentage points from banks with the largest share during the shock period. According to Table 1, the mean total borrowings are 2.751 percentage points, so we interpret that the effects of bank ranking \( ^1 \times \text{shock} \) are economically significant. In Column (2), the estimated coefficient of bank ranking \( ^2 \times \text{shock} \) is positive and statistically significant at the 10% level. This shows that firms increased short-term borrowings by 0.183 percentage points from banks with the largest share during the shock period. Column (3) shows the estimation results using long-term borrowings as the dependent variable. The estimated coefficient of bank ranking \( ^1 \times \text{shock} \) is positive, but not statistically significant. Similarly, in Columns (1) and (2), the estimated coefficients of bank ranking \( ^2 \times \text{shock} \) are positive and statistically significant at the 5% or 10% levels. The magnitudes of the coefficients are smaller than those of the bank ranking \( ^1 \times \text{shock} \). This suggests that banks with the second-largest share increased their amount of short-term loans after the shock more than banks with low lending shares. By contrast, the estimated coefficients of bank ranking \( \times \text{shock} \) on total bank borrowings are not statistically significant if a bank’s lending share is the third largest. Focusing on the magnitude of the estimated coefficients, we see that \( \beta^1_2 > \beta^2_2 > \beta^3_2 \) is supported. These results imply that banks offered more loans during the COVID-19 shock if they had the first- or second-largest lending shares. These results are consistent with the notion that banks that had close relationships with borrowing firms offered liquidity to these firms during the shock.

In Columns (4)–(6), we show the estimation results for Equation (1) using firms’ control variables instead of firm \( \times \) year fixed effects. The estimated coefficients of bank ranking \( ^1 \times \text{shock} \) are positive and statistically significant at the 1% or 5% level. Furthermore, those of bank ranking \( ^2 \times \text{shock} \) are positive and statistically
TABLE 1 Summary statistics

| Variable                                      | Obs  | Mean   | SD    | Min   | Max   |
|-----------------------------------------------|------|--------|-------|-------|-------|
| Total bank borrowing/total assets            | 24,844 | 0.02751 | 0.03903 | 0.00001 | 0.65096 |
| Short-term bank borrowing/total assets       | 24,844 | 0.00915 | 0.02094 | 0.00000 | 0.45210 |
| Long-term bank borrowing/total assets        | 24,844 | 0.01835 | 0.03085 | 0.00000 | 0.43947 |
| Total bank borrowing/total debts             | 24,844 | 0.05214 | 0.06843 | 0.00001 | 0.82072 |
| Short-term bank borrowing/total debts        | 24,844 | 0.03438 | 0.05573 | 0.00000 | 0.76655 |
| Long-term bank borrowing/total debts         | 24,844 | 0.01776 | 0.03782 | 0.00000 | 0.71190 |
| Bank ranking\(^1\)                           | 24,844 | 0.14700 | 0.35411 | 0.00000 | 1.00000 |
| Bank ranking\(^2\)                           | 24,844 | 0.13891 | 0.34586 | 0.00000 | 1.00000 |
| Bank ranking\(^3\)                           | 24,844 | 0.12112 | 0.32627 | 0.00000 | 1.00000 |
| Firm size                                    | 23,663 | 10.61969 | 1.49063 | 6.16542 | 16.20027 |
| Cash flow                                    | 23,663 | 0.04190 | 0.05567 | –0.74809 | 0.40437 |
| Leverage                                     | 23,395 | 0.53616 | 0.17403 | 0.01530 | 1.35085 |
| Cash holding ratio                           | 23,395 | 0.13663 | 0.11870 | 0.00001 | 0.96669 |
| Tangibility                                  | 23,349 | 0.25761 | 0.19404 | 0.00004 | 0.91940 |

Note: This table provides summary statistics for the variables used in the econometric analysis.

significant at the 5% level in Columns (4) and (6). Focusing on the estimation results of the characteristics and financial conditions of firms, we see that the estimated coefficients of cash flow are negative and statistically significant at the 1% level. This suggests that firms use more bank loans when their cash flows decrease. In addition, the estimated coefficients of leverage are positive in Columns (4) and (6), suggesting that highly leveraged firms use more bank loans.

For the robustness check, we also estimate Equation (1) using bank borrowings from bank \(j\) for firm \(i\), normalized by total debt. The estimated results are presented in Table 3. In all columns, the estimated coefficients of the bank ranking\(^1\) × shock are positive. However, these coefficients are not statistically significant. Focusing on the bank ranking\(^2\) × shock, we see that the estimated coefficients are positive and statistically significant at the 5% level in Column (1).

Columns (4)–(6) show the estimation results for bank borrowing normalized by total debt using firms’ control variables instead of firm × year fixed effects. The estimated coefficients of bank ranking\(^1\) × shock are positive and statistically significant in Columns (4) and (5). In addition, those of the bank ranking\(^2\) × shock are positive and statistically significant. Moreover, \(\hat{\beta}_1 > \hat{\beta}_2 > \hat{\beta}_3\) is supported. In summary, the estimation results of Equation (1) are not robust if we use bank borrowing normalized by total debt.

3.2 Estimation results for Equation (2)

Table 4 presents the estimation results for Equation (2). The dependent variables in each column are similar to those in Table 2. The estimation results of bank ranking\(^1,2,3\) and bank ranking\(^1,2,3\) × shock are similar to those presented in Table 2. The estimated coefficients of bank ranking\(^1,2,3\) × cash flow are negative and statistically significant at the 1% level in Columns (1) and (2). In addition, this coefficient is negative and statistically significant in Column (3) if the bank ranking is the largest. These results suggest that banks offer more short- and long-term loans to firms whose cash flows are low if the relationships between them are close. In all columns, the magnitude of the estimated coefficients is higher if the rank of the banks is higher. This also suggests that banks with closer relationships with firms offer more bank loans if a firm’s cash flow is low.

To investigate the effects of bank ranking\(^1,2,3\) × cash flow during the COVID-19 shock, we estimate the coefficients of bank ranking\(^1,2,3\) × cash flow × shock. In Columns (1) and (3), the estimated coefficients of bank ranking\(^1\) × cash flow × shock are negative and statistically significant at the 10% level. This finding suggests that banks offered more (long-term) loans to firms whose cash flow decreased during the shock period if the bank had the largest share of this firm. In Column (3), the estimated coefficient of bank ranking\(^2\) × cash flow × shock is also negative and statistically significant at the 5% level. Focusing on the magnitude of the estimated coefficients for total bank borrowing, the negative effects of bank ranking\(^1\) are larger than those of bank ranking\(^2\). The estimated coefficients of bank ranking\(^3\) × cash flow × shock are positive or not statistically significant.

In Columns (4)–(6), we add firms’ control variables instead of firm × year fixed effects. The estimation results show that the coefficients of bank ranking\(^1\) × cash flow are negative and statistically significant at the 1% level. This suggests that banks offer more loans to firms that decrease cash flows. The estimated effects of bank ranking\(^1\) × cash flow are larger than those of bank ranking\(^2,3\) × cash flow, so banks with the closest relationships offered more loans. However, the estimated coefficients of bank ranking\(^1\) × cash flow × shock are not statistically significant. This suggests that banks offered more
| (1) Total Bank borrowing (normalized by asset) | (2) Short term Bank borrowing | (3) Long term Bank borrowing |
|---------------------------------------------|-------------------------------|-----------------------------|
| Bank ranking^1 0.0544*** (0.00249) | 0.0174*** (0.00130) | 0.0370*** (0.00164) |
| Bank ranking^2 0.0249*** (0.00102) | 0.00748*** (0.000664) | 0.0175*** (0.000869) |
| Bank ranking^3 0.0136*** (0.000738) | 0.00394*** (0.000503) | 0.00970*** (0.000544) |
| Bank ranking^1 × shock 0.00439*** (0.00211) | 0.00183* (0.000995) | 0.00256 (0.00166) |
| Bank ranking^2 × shock 0.00227*** (0.00102) | 0.000956* (0.000552) | 0.00132 (0.000843) |
| Bank ranking^3 × shock 0.000756 (0.000751) | −0.000373 (0.000456) | 0.00113* (0.000660) |
| Bank fixed effects Yes | Yes | Yes |
| Firm fixed effects Yes | Yes | Yes |
| Year fixed effects Yes | Yes | Yes |
| Bank × year fixed effects Yes | Yes | Yes |
| Firm × year fixed effects Yes | Yes | Yes |
| Number of observations 24,844 24,844 24,844 | | |
| \$^2 | .619 | .545 | .587 |

| (4) Total Bank borrowing (normalized by asset) | (5) Short term Bank borrowing | (6) Long term Bank borrowing |
|---------------------------------------------|-------------------------------|-----------------------------|
| Bank ranking^1 0.0507*** (0.00261) | 0.0163*** (0.00142) | 0.0345*** (0.00158) |
| Bank ranking^2 0.0226*** (0.00101) | 0.00670*** (0.000658) | 0.0159*** (0.000768) |
| Bank ranking^3 0.0114*** (0.000649) | 0.00324*** (0.000464) | 0.00818*** (0.000488) |
| Bank ranking^1 × shock 0.00427*** (0.00155) | 0.00167** (0.000811) | 0.00260** (0.00115) |
| Bank ranking^2 × shock 0.00194** (0.000790) | 0.000517 (0.000444) | 0.00142** (0.000653) |
| Bank ranking^3 × shock 0.000469 (0.000674) | −0.000342 (0.000402) | 0.000812 (0.000618) |
| Firm size 0.000830 (0.000456) | 0.00182 (0.000226) | −0.000988 (0.000416) |
| Cash flow −0.0802*** (0.0120) | −0.0465*** (0.0111) | −0.0337*** (0.00637) |
| Leverage 0.0328*** (0.00691) | 0.00580 (0.00469) | 0.0270*** (0.00686) |
| Cash holding ratio −0.00742 (0.00741) | 0.00288 (0.00412) | −0.0103 (0.00843) |

(Continues)
loans to firms that decreased cash flow during both shock and non-shock periods. For the robustness check, Table 5 shows the estimation results for Equation (2) using bank borrowing normalized by total debt. The estimation results of bank ranking\(^3\) \times\) cash flow \times shock are similar to those presented in Columns (4)–(6) of Table 4.

### 3.3 Heterogeneous effects by year

In the previous subsection, we show that banks with the largest share offered more loans to firms after the shock. However, this result is not robust because the estimated coefficients of bank ranking\(^3\) are not statistically significant if we use bank borrowing normalized by total debt (as shown in Columns (1)–(3) of Table 3). Furthermore, although the estimated coefficients of bank ranking\(^1,2,3\) \times\) cash flow are negative and statistically significant at the 1% level, those of bank ranking\(^1,2,3\) \times\) cash flow \times shock are statistically insignificant if we use bank borrowing normalized by total debt. We predict that the heterogeneous effects of insurance drive these results. If banks offer loans to liquidity shortages caused by sudden economic shocks, the effects of insurance are larger when the magnitude of the shock is more opaque. The effects of the magnitude of the shock were more opaque at the beginning of the shock period. Therefore, we predict that the effects of lending relationships will be larger in 2020. To test this hypothesis, we estimated the following equation:

\[
\text{Bank Borrowings}_{it} = \sum_{r=1,2,3} \beta_r^{\text{Bank Ranking}_{ij,t-1}} + \sum_{r=1,2,3} \gamma_r^{\text{Bank Ranking}_{ij,t-1} \times \text{Shock}(2020)_{it}} + \sum_{r=1,2,3} \delta_r^{\text{Bank Ranking}_{ij,t-1} \times \text{Shock}(2021)_{it}} + \epsilon_i + \zeta_j + \eta_t + \theta_{ij,t},
\]

where \text{Shock}(2020)_{it} or \text{Shock}(2021)_{it} is a dummy variable that equals 1 if the year is 2020 or 2021. The definitions of the other variables are the same as those in Equation (1). We also estimate the heterogeneous effects of cash flow by year using the following equation:

\[
\text{Bank Borrowings}_{it} = \sum_{r=1,2,3} \beta_r^{\text{Bank Ranking}_{ij,t-1}} + \sum_{r=1,2,3} \gamma_r^{\text{Bank Ranking}_{ij,t-1} \times \text{Cash Flow}_{it}} + \sum_{r=1,2,3} \delta_r^{\text{Bank Ranking}_{ij,t-1} \times \text{Cash Flow}_{it} \times \text{Shock}(2020)_{it}} + \sum_{r=1,2,3} \epsilon_i + \zeta_j + \eta_t + \theta_{ij,t},
\]

where the definitions of the other variables are the same as those in Equation (2).

The estimation results for Equation (3), using bank borrowing normalized total assets as a dependent variable, are shown in Table 6. In
|                  | (1) Total Bank borrowing (normalized by debt) | (2) Short term Bank borrowing | (3) Long term Bank borrowing |
|------------------|---------------------------------------------|------------------------------|------------------------------|
|                  | (4) Total Bank borrowing (normalized by debt) | (5) Short term Bank borrowing | (6) Long term Bank borrowing |
|                  |                                             |                              |                              |
| Bank ranking¹    | 0.101***                                    | 0.0325***                    | 0.0689***                    |
|                  | (0.00408)                                   | (0.00226)                    | (0.00274)                    |
| Bank ranking²    | 0.0431***                                   | 0.0130***                    | 0.0301***                    |
|                  | (0.00170)                                   | (0.00117)                    | (0.00154)                    |
| Bank ranking³    | 0.0218***                                   | 0.00610***                   | 0.0157**                     |
|                  | (0.00125)                                   | (0.000780)                   | (0.00101)                    |
| Bank ranking¹ × shock | 0.00390                                   | 0.00184                      | 0.00206                      |
|                  | (0.00282)                                   | (0.00150)                    | (0.00245)                    |
| Bank ranking² × shock | 0.00355**                                | 0.00155                      | 0.00200                      |
|                  | (0.00172)                                   | (0.00108)                    | (0.00135)                    |
| Bank ranking³ × shock | 0.00151                                   | -0.000435                    | 0.00195*                     |
|                  | (0.00135)                                   | (0.000772)                   | (0.00115)                    |
| Bank fixed effects | Yes                                        | Yes                          | Yes                          |
| Firm fixed effects | Yes                                        | Yes                          | Yes                          |
| Year fixed effects | Yes                                        | Yes                          | Yes                          |
| Bank × year fixed effects | Yes                                    | Yes                          | Yes                          |
| Firm × year fixed effects | Yes                                    | Yes                          | Yes                          |
| Number of observations | 24,844                                      | 24,844                       | 24,844                       |
| R²               | .657                                       | .595                         | .618                         |

(Continues)
all columns of Table 6, the estimated coefficients of bank ranking1 × shock(2020) are positive and statistically significant. Those of bank ranking2 × shock(2020) are also positive and statistically significant in Columns (1) and (2), while those of bank ranking2 × shock(2020) are insignificant. In addition, $\hat{\beta}_1 > \hat{\beta}_2 > \hat{\beta}_3$ is supported in 2020. Table 7 shows the estimation results using bank borrowing-normalized total debt as the dependent variable. Table 7 shows that the estimated coefficients of bank ranking1,2 × cash flow are negative and statistically significant in Column (1). By contrast, these coefficients are statistically insignificant in 2021. These estimation results imply that banks with close relationships offer more loans to firms at the beginning of a sudden economic shock.

Table 8 presents the estimation results for Equation (4). The estimated coefficients of bank ranking1,2,3 × cash flow are negative and statistically significant in Columns (1) and (2). In Column (3), only the estimated coefficient of bank ranking1 × cash flow is statistically significant. $\hat{\gamma}_1 > \hat{\gamma}_2 > \hat{\gamma}_3$ is supported, so banks with close relationships offer more loans if firms experience cash flow shocks. The estimated coefficients of bank ranking1 × cash flow × shock(2020) are negative and statistically significant in 2020. In contrast, the coefficients for 2021 are statistically insignificant, so they are supported only at the beginning of the shock. Table 9 shows the estimation results for Equation (4), using bank borrowing normalized total debt as a dependent variable. The estimated coefficient of bank ranking1 × cash flow × shock(2020) is negative and statistically significant in 2020, while this is not supported in 2021. In summary, the liquidity insurance hypothesis is supported in 2020, which is the beginning of the shock period.

We show the marginal effects of cash flow by year and bank ranking in Figure 1. We replace the shock dummy with year dummies in Equation (2) to estimate the marginal effects by year and bank rankings. The magnitude of the estimated coefficients of cash flow is the largest if bank ranking is first. In addition, if bank ranking is first, the magnitude of the estimated coefficients is larger in 2020 and 2021 than in 2018 and 2019. The coefficients largely changed between 2019 and 2020, before and after the COVID-19 shock. This implies that the credit supply from banks with the largest share largely increased between 2019 and 2020.

Focusing on the estimated coefficients for second-bank ranking, we can see similar trends to those of the first-bank ranking, but these trends are weak. If bank ranking is third or later, the magnitude of the estimated coefficients of cash flow will not be larger for 2020 compared with those for 2018 and 2019. These results suggest that banks with close relationships with borrowing firms offer more loans to these firms before and during the shock. Furthermore, the effects are larger during the shock period. This is consistent with the notion that banks with close relationships with borrowing firms offer more loans to these firms to finance cash flow shocks during a shock.

Focusing on 2021, we see that the marginal effects of cash flow are largely changed in 3rd and later ranking banks. This implies that banks with lower rankings offered more loans to firms that decreased cash flow in 2021, while banks with the largest lending share still offered loans to these firms. This is considered the main cause of the insignificant effects of bank ranking1 in 2021.

### Table 3 (Continued)

|                      | (4) Total Bank borrowing (normalized by debt) | (5) Short term Bank borrowing | (6) Long term Bank borrowing |
|----------------------|-----------------------------------------------|-------------------------------|-------------------------------|
|                      | (0.00634)                                    | −0.0306                       | 0.0370                        |
|                      | (0.0182)                                     | (0.0226)                      | (0.0260)                      |
| Tangibility          |                                               |                               |                               |
| Bank fixed effects   | Yes                                           | Yes                           | Yes                           |
| Firm fixed effects   | Yes                                           | Yes                           | Yes                           |
| Year fixed effects   | Yes                                           | Yes                           | Yes                           |
| Bank × year fixed effects | No                                      | No                             | No                             |
| Firm × year fixed effects | No                                      | No                             | No                             |
| Number of observations | 23,565                                      | 23,565                        | 23,565                        |
| $R^2$                | .630                                          | .550                          | .578                          |

Note: This table presents estimates with bank borrowings (normalized by a firm’s total debt) as the dependent variable. The definitions of the independent variables are the same as those listed in Table 2. The estimated standard errors based on clustering across firms and banks are in parentheses.

*Significance at the 10% level.

**Significance at the 5% level.

***Significance at the 1% level.
|                        | (1) Total Bank borrowing (normalized by asset) | (2) Short term Bank borrowing | (3) Long term Bank borrowing |
|------------------------|-----------------------------------------------|--------------------------------|-------------------------------|
| Bank ranking\(^1\)     | 0.0621*** (0.00284)                           | 0.0217*** (0.00157)           | 0.0404*** (0.00193)           |
| Bank ranking\(^2\)     | 0.0282*** (0.00154)                           | 0.0103*** (0.00101)           | 0.0179*** (0.00136)           |
| Bank ranking\(^3\)     | 0.0152*** (0.00118)                           | 0.00586*** (0.000907)         | 0.00935*** (0.000847)         |
| Bank ranking\(^1\) × cash flow | -0.180*** (0.0355)                           | -0.0971*** (0.0179)           | -0.0829*** (0.0243)           |
| Bank ranking\(^2\) × cash flow | -0.0795*** (0.0223)                           | -0.0650*** (0.0136)           | -0.0144 (0.0201)              |
| Bank ranking\(^3\) × cash flow | -0.0450** (0.0178)                           | -0.0457*** (0.0146)           | 0.000687 (0.0143)             |
| Bank ranking\(^1\) × shock | 0.00580* (0.00308)                           | 0.00158 (0.00142)             | 0.00422* (0.00247)            |
| Bank ranking\(^2\) × shock | 0.00339* (0.00184)                           | -0.000365 (0.00102)           | 0.00375** (0.00148)           |
| Bank ranking\(^3\) × shock | 0.000762 (0.00147)                           | -0.00183* (0.00105)           | 0.00259*** (0.000976)         |
| Bank ranking\(^1\) × cash flow × shock | -0.0769* (0.0419)                           | -0.0198 (0.0227)             | -0.0571* (0.0323)             |
| Bank ranking\(^2\) × cash flow × shock | -0.0480 (0.0297)                           | 0.0128 (0.0199)               | -0.0608** (0.0245)            |
| Bank ranking\(^3\) × cash flow × shock | -0.00654 (0.0254)                           | 0.0265 (0.0230)               | -0.0331* (0.0172)             |
| Bank fixed effects     | Yes                                           | Yes                            | Yes                           |
| Firm fixed effects     | Yes                                           | Yes                            | Yes                           |
| Year fixed effects     | Yes                                           | Yes                            | Yes                           |
| Bank × year fixed effects | Yes                                        | Yes                            | Yes                           |
| Firm × year fixed effects | Yes                                        | Yes                            | Yes                           |
| Number of observations | 23,663                                        | 23,663                         | 23,663                        |
| \(R^2\)               | .623                                         | .556                           | .584                          |

(Continues)
|                               | (4) Total Bank borrowing (normalized by asset) | (5) Short term Bank borrowing | (6) Long term Bank borrowing |
|-------------------------------|------------------------------------------------|-------------------------------|-------------------------------|
| Bank ranking$^2 \times$ cash flow | $-0.0865^{***}$ (0.0228)                      | $-0.0664^{***}$ (0.0132)      | $-0.0202$ (0.0191)            |
| Bank ranking$^3 \times$ cash flow | $-0.0493^{***}$ (0.0156)                      | $-0.0454^{***}$ (0.0116)      | $-0.00392$ (0.0120)           |
| Bank ranking$^1 \times$ shock   | 0.00410 (0.00289)                              | 0.000818 (0.00131)            | 0.00328 (0.00230)             |
| Bank ranking$^2 \times$ shock   | 0.00149 (0.00154)                              | $-0.00145$ (0.00107)          | 0.00294$^{***}$ (0.00108)     |
| Bank ranking$^3 \times$ shock   | $-0.000537$ (0.00128)                         | $-0.00227^{***}$ (0.00103)    | 0.00173$^*$ (0.000953)         |
| Bank ranking$^1 \times$ cash flow $\times$ shock | $-0.0424$ (0.0488)                         | 0.00142 (0.0216)              | $-0.0438$ (0.0400)            |
| Bank ranking$^2 \times$ cash flow $\times$ shock | $-0.0106$ (0.0287)                         | 0.0382$^*$ (0.0218)           | $-0.0488^{***}$ (0.182)       |
| Bank ranking$^3 \times$ cash flow $\times$ shock | 0.0164 (0.0209)                              | 0.0438$^{**}$ (0.0213)        | $-0.0274^*$ (0.0164)          |
| Firm size                     | 0.00342 (0.00481)                             | 0.00378 (0.00237)             | $-0.000354$ (0.00040)         |
| Cash flow                     | $-0.0211^*$ (0.0116)                         | $-0.00133$ (0.00723)          | $-0.0198^{**}$ (0.00910)      |
| Cash flow $\times$ shock      | $-0.0154$ (0.0143)                           | $-0.0386^{***}$ (0.0135)      | 0.0232$^{**}$ (0.00918)       |
| Leverage                      | 0.0290$^{***}$ (0.00701)                     | 0.00163 (0.00460)             | 0.0274$^{***}$ (0.00746)      |
| Cash holding ratio            | $-0.00662$ (0.00734)                        | 0.00267 (0.00430)             | $-0.00930$ (0.00812)          |
| Tangibility                   | 0.00699 (0.0122)                             | $-0.0114$ (0.00840)           | 0.0184 (0.0173)               |
| Bank fixed effects            | Yes                                          | Yes                           | Yes                           |
| Firm fixed effects            | Yes                                          | Yes                           | Yes                           |
| Year fixed effects            | Yes                                          | Yes                           | Yes                           |
| Bank $\times$ year fixed effects | No                                          | No                            | No                            |
| Firm $\times$ year fixed effects | No                                          | No                            | No                            |
| Number of observations        | 23,565                                       | 23,565                        | 23,565                        |
| $R^2$                         | .593                                         | .514                          | .544                          |

Note: This table presents estimates with bank borrowings (normalized by a firm's total assets) as the dependent variable. The definitions of the independent variables are the same as those listed in Table 2. The estimated standard errors based on clustering across firms and banks are shown in parentheses.

*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.
### Table 5  
Estimation results for bank borrowings, bank ranking, and cash flow (robustness check)

|                         | (1) Total Bank borrowing (normalized by debt) | (2) Short term Bank borrowing | (3) Long term Bank borrowing |
|-------------------------|-----------------------------------------------|-------------------------------|-------------------------------|
| Bank ranking¹           | 0.110***                                      | 0.0376***                     | 0.0724***                     |
|                         | (0.00440)                                     | (0.00246)                     | (0.00316)                     |
| Bank ranking²           | 0.0473***                                     | 0.0166***                     | 0.0308***                     |
|                         | (0.00256)                                     | (0.00163)                     | (0.00224)                     |
| Bank ranking³           | 0.0234***                                     | 0.00855***                    | 0.0148***                     |
|                         | (0.00186)                                     | (0.00126)                     | (0.00140)                     |
| Bank ranking¹ × cash flow| −0.211***                                     | −0.122***                     | −0.0888***                    |
|                         | (0.0610)                                      | (0.0304)                      | (0.0417)                      |
| Bank ranking² × cash flow| −0.0999**                                     | −0.0847***                    | −0.0152                       |
|                         | (0.0413)                                      | (0.0186)                      | (0.0321)                      |
| Bank ranking³ × cash flow| −0.0451                                       | −0.0555***                    | 0.0104                        |
|                         | (0.0308)                                      | (0.0184)                      | (0.0248)                      |
| Bank ranking¹ × shock   | 0.00665                                       | 0.00221                       | 0.00444                       |
|                         | (0.00466)                                     | (0.00220)                     | (0.00388)                     |
| Bank ranking² × shock   | 0.00374                                       | 0.00004                       | 0.00370*                      |
|                         | (0.00285)                                     | (0.00164)                     | (0.00216)                     |
| Bank ranking³ × shock   | 0.000953                                      | −0.00257*                     | 0.00352**                     |
|                         | (0.00230)                                     | (0.00132)                     | (0.00159)                     |
| Bank ranking¹ × cash flow × shock | −0.1030                                       | −0.0341                       | −0.0690                       |
|                         | (0.0706)                                      | (0.0370)                      | (0.0524)                      |
| Bank ranking² × cash flow × shock | −0.0279                                       | 0.0149                        | −0.0428                       |
|                         | (0.0490)                                      | (0.0297)                      | (0.0361)                      |
| Bank ranking³ × cash flow × shock | 0.00630                                       | 0.0373                        | −0.0310                       |
|                         | (0.0389)                                      | (0.0287)                      | (0.0279)                      |
| Bank fixed effects      | Yes                                           | Yes                           | Yes                           |
| Firm fixed effects      | Yes                                           | Yes                           | Yes                           |
| Year fixed effects      | Yes                                           | Yes                           | Yes                           |
| Bank × year fixed effects| Yes                                           | Yes                           | Yes                           |
| Firm × year fixed effects| Yes                                           | Yes                           | Yes                           |
| Number of observations  | 23,663                                        | 23,663                        | 23,663                        |
| R²                      | .657                                          | .597                          | .613                          |

|                         | (4) Total Bank borrowing (normalized by debt) | (5) Short term Bank borrowing | (6) Long term Bank borrowing |
|-------------------------|-----------------------------------------------|-------------------------------|-------------------------------|
| Bank ranking¹           | 0.104***                                      | 0.0360***                     | 0.0682***                     |
|                         | (0.00420)                                     | (0.00256)                     | (0.00275)                     |
| Bank ranking²           | 0.0439***                                     | 0.0155***                     | 0.0284***                     |
|                         | (0.00239)                                     | (0.00159)                     | (0.00188)                     |
| Bank ranking³           | 0.0203***                                     | 0.00755***                    | 0.0127***                     |
|                         | (0.00188)                                     | (0.00119)                     | (0.00127)                     |
| Bank ranking¹ × cash flow| −0.208***                                     | −0.126***                     | −0.0812***                    |
|                         | (0.0569)                                      | (0.0309)                      | (0.0363)                      |

(Continues)
Note: This table presents estimates with bank borrowings (normalized by a firm's total debt) as the dependent variable. The definitions of the independent variables are the same as those listed in Table 2. The estimated standard errors based on clustering across firms and banks are shown in parentheses.

*Significance at the 10% level.

**Significance at the 5% level.

***Significance at the 1% level.
3.4 | Effects of bank ownership

In the previous section, we show that banks with the largest lending share offer more loans to firms during the shock period. However, many banks are also likely to be large shareholders in Japan. For example, Morck et al. (2000) show that the average percentage of shareholdings of main banks is 3.59%, suggesting that main banks are also the main shareholders. Therefore, the estimation results can be driven by the large shareholding of banks instead of lending relationships. We can acquire data on the percentage of shareholdings of the top 30 shareholders from the Nikkei Financial Quest database, so we investigate whether lending relationships or large shareholdings are significant for liquidity provision during the shock.

Table 10 shows the descriptive statistics of the shareholdings of bank j for firm i by bank ranking. This table shows that the mean shareholding ratio of banks with the largest lending share is 0.0189, which is the largest value. The second largest mean shareholding ratio is for banks with the second-largest lending share. This trend is similar for banks with a third or later lending share. This suggests that banks with larger lending shares also have larger shareholding ratios. However, compared with Morck et al. (2000), the mean shareholding ratio of banks in our database is lower. As Miyajima and Kuroki (2007) argued, the shareholding ratio of banks decreased during the 2000s because of the burden of nonperforming loans and asset restructuring of banks. Table 10 is consistent with the results of Miyajima and Kuroki (2007). The 25th percentile of shareholding ratios is zero.

| (1) Total Bank borrowing (normalized by asset) | (2) Short term Bank borrowing | (3) Long term Bank borrowing |
|-----------------------------------------------|-------------------------------|-------------------------------|
| Bank ranking<sup>1</sup>                      | 0.0544***                    | 0.0174***                    | 0.0370***                    |
|                                               | (0.00249)                    | (0.00130)                    | (0.00164)                    |
| Bank ranking<sup>2</sup>                      | 0.0249***                    | 0.00748***                   | 0.0175***                    |
|                                               | (0.00102)                    | (0.000664)                   | (0.000869)                   |
| Bank ranking<sup>3</sup>                      | 0.0136***                    | 0.00394***                   | 0.00970***                   |
|                                               | (0.000738)                   | (0.000503)                   | (0.000544)                   |
| Bank ranking<sup>1</sup> × shock(2020)         | 0.00514***                   | 0.00195*                     | 0.00319**                    |
|                                               | (0.00175)                    | (0.00101)                    | (0.00139)                    |
| Bank ranking<sup>2</sup> × shock(2020)         | 0.00292**                    | 0.00169***                   | 0.00122                      |
|                                               | (0.00114)                    | (0.000603)                   | (0.000928)                   |
| Bank ranking<sup>3</sup> × shock(2020)         | 0.00111                      | 0.000167                     | 0.000946                     |
|                                               | (0.000951)                   | (0.000565)                   | (0.000697)                   |
| Bank ranking<sup>1</sup> × shock(2021)         | 0.00354                      | 0.00170                      | 0.00184                      |
|                                               | (0.00276)                    | (0.00117)                    | (0.00225)                    |
| Bank ranking<sup>2</sup> × shock(2021)         | 0.00155                      | 0.000124                     | 0.00143                      |
|                                               | (0.00120)                    | (0.000662)                   | (0.00106)                    |
| Bank ranking<sup>3</sup> × shock(2021)         | 0.000349                     | −0.000991                    | 0.00134*                     |
|                                               | (0.000825)                   | (0.000612)                   | (0.000776)                   |

Note: This table presents estimates with bank borrowings (normalized by a firm’s total assets) as the dependent variable. Shock(2020) and shock(2021) are dummy variables equal to 1 if year = 2020 and 2021, respectively. The definitions of the independent variables are the same as those listed in Table 2. The estimated standard errors based on clustering across firms and banks are shown in parentheses.

*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.
suggesting that some banks do not hold shares of borrowing firms, even if the lending share is the largest or second largest.

In Table 10, we also show the ratio of banks, which is the large shareholding of borrowing firms. This table suggests that 56.85 percent of banks are the top 10 shareholders of borrowing firms if banks’ lending share is the largest. This table suggests that banks are likely to be large shareholders if they have close lending relationships. If we focus on the top three shareholders, we obtain similar results.

To investigate whether lending relationships or shareholding is significant for liquidity provision during a shock, we estimate the following equation:

\[
\text{Bank Borrowings}_{ijt} = \sum_{r=1,2,3} \delta^r \text{Bank Ranking}_{ijt-1} + \sum_{r=1,2,3} \delta^r \text{Bank Ownership}_{ijt} \times \text{Shock}_{it} + \delta_4 \text{Bank Ownership}_{ijt} \times \text{Shock}_{it} + \epsilon_i + \zeta_j + \eta_t + \epsilon_i \times \eta_t + \zeta_j \times \eta_t + \theta_{ijt},
\]

where \(\text{Bank Ownership}_{ijt}\) is the shareholding ratio of bank \(j\) for firm \(i\) in year \(t\), the top 3 shareholders dummy of bank \(j\) for firm \(i\) in year \(t\), or the top 10 shareholders dummy of bank \(j\) for firm \(i\) in year \(t\).
Table 8: Estimation results for bank borrowings, bank ranking, and cash flow, by shock year

|                      | (1) Total Bank borrowing (normalized by asset) | (2) Short term Bank borrowing | (3) Long term Bank borrowing |
|----------------------|---------------------------------------------|-------------------------------|------------------------------|
|                      | (1) | (2) | (3)                      | (1) | (2) | (3)                      | (1) | (2) | (3)                      |
| Bank ranking\(^1\)   | 0.0621*** | 0.0217*** | 0.0404***                | (0.00284) | (0.00157) | (0.00193)              |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^2\)   | 0.0282*** | 0.0103*** | 0.0179***                | (0.00154) | (0.00101) | (0.00136)              |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^3\)   | 0.0152*** | 0.00586*** | 0.00935***               | (0.00118) | (0.000907) | (0.000847)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^1\) × cash flow | -0.180*** | -0.0971*** | -0.0829***               | (0.0355) | (0.0179) | (0.0243)              |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^2\) × cash flow | -0.0795*** | -0.0550*** | -0.0144                  | (0.0223) | (0.0136) | (0.0201)              |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^3\) × cash flow | -0.0450**  | -0.0457*** | 0.000687                 | (0.0178) | (0.0146) | (0.0143)              |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^1\) × shock(2020) | 0.00108*** | 0.00355** | 0.00729***               | (0.00299) | (0.00166) | (0.00226)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^2\) × shock(2020) | 0.00483**  | 0.000437 | 0.00439**                 | (0.00219) | (0.00127) | (0.00180)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^3\) × shock(2020) | 0.000920 | -0.00135 | 0.00227**                 | (0.00155) | (0.00127) | (0.000909)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^1\) × shock(2021) | 0.00223 | 0.000207 | 0.00203                   | (0.00368) | (0.00172) | (0.00313)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^2\) × shock(2021) | 0.00211 | -0.00117 | 0.00328**                 | (0.00201) | (0.00121) | (0.00160)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^3\) × shock(2021) | 0.000842 | -0.00224*  | 0.00308***                | (0.00161) | (0.00114) | (0.00115)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^1\) × cash flow × shock(2020) | -0.155*** | -0.0514*  | -0.104***                | (0.0536) | (0.0306) | (0.0361)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^2\) × cash flow × shock(2020) | -0.0571 | 0.0127 | -0.0698**                 | (0.0380) | (0.0275) | (0.0308)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^3\) × cash flow × shock(2020) | 0.00711 | 0.0319 | -0.0248                   | (0.0275) | (0.0260) | (0.0174)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^1\) × cash flow × shock(2021) | -0.0289 | -0.000207 | -0.0287                  | (0.0454) | (0.0309) | (0.0375)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^2\) × cash flow × shock(2021) | -0.0466 | 0.00960 | -0.0562**                | (0.0347) | (0.0241) | (0.0256)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank ranking\(^3\) × cash flow × shock(2021) | -0.0314 | 0.0158 | -0.0472**                | (0.0344) | (0.0299) | (0.0238)           |
|                      |     |     |                          |     |     |                          |     |     |                          |
| Bank fixed effects   | Yes | Yes | Yes                      | Yes | Yes | Yes                      |
| Firm fixed effects   | Yes | Yes | Yes                      | Yes | Yes | Yes                      |
| Year fixed effects   | Yes | Yes | Yes                      | Yes | Yes | Yes                      |
| Bank × year fixed effects | Yes | Yes | Yes                      | Yes | Yes | Yes                      |
| Firm × year fixed effects | Yes | Yes | Yes                      | Yes | Yes | Yes                      |
| Number of observations | 23,663 | 23,663 | 23,663                   | 23,663 | 23,663 | 23,663               |
| \(R^2\)              | .623 | .556 | .584                     | .623 | .556 | .584                   |

Note: This table presents estimates with bank borrowings (normalized by a firm’s total assets) as the dependent variable. The definitions of the independent variables are the same as those in Tables 2 and 6. The estimated standard errors based on clustering across firms and banks are shown in parentheses.

*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.
| (1) Total Bank borrowing (normalized by debt) | (2) Short term Bank borrowing | (3) Long term Bank borrowing |
|---------------------------------------------|-----------------------------|-----------------------------|
| Bank ranking\(^1\) | 0.110*** (0.00440) | 0.0376*** (0.00246) | 0.0724*** (0.00316) |
| Bank ranking\(^2\) | 0.0473*** (0.00256) | 0.0166*** (0.00163) | 0.0308*** (0.00224) |
| Bank ranking\(^3\) | 0.0234*** (0.00186) | 0.00855*** (0.00126) | 0.0148*** (0.00140) |
| Bank ranking\(^1\) × cash flow | −0.211*** (0.0610) | −0.122*** (0.0304) | −0.0888*** (0.0417) |
| Bank ranking\(^2\) × cash flow | −0.0999*** (0.0413) | −0.0847*** (0.0187) | −0.0152 (0.0321) |
| Bank ranking\(^3\) × cash flow | −0.0451 (0.0308) | −0.0555*** (0.0184) | 0.0104 (0.0248) |
| Bank ranking\(^1\) × shock(2020) | 0.0155*** (0.00519) | 0.00515** (0.00250) | 0.0104** (0.00404) |
| Bank ranking\(^2\) × shock(2020) | 0.00615* (0.00345) | 0.00155 (0.00198) | 0.00460* (0.00254) |
| Bank ranking\(^3\) × shock(2020) | 0.000950 (0.00256) | −0.00172 (0.00169) | 0.00267 (0.00174) |
| Bank ranking\(^1\) × shock(2021) | 0.000579 (0.00537) | 0.000282 (0.00269) | 0.000298 (0.000470) |
| Bank ranking\(^2\) × shock(2021) | 0.00178 (0.00301) | −0.00131 (0.00186) | 0.00309 (0.00249) |
| Bank ranking\(^3\) × shock(2021) | 0.00146 (0.00251) | −0.00325*** (0.00155) | 0.00471** (0.00181) |
| Bank ranking\(^1\) × cash flow × shock(2020) | −0.249*** (0.0940) | −0.0875* (0.0492) | −0.161** (0.0657) |
| Bank ranking\(^2\) × cash flow × shock(2020) | −0.0531 (0.0652) | 0.00376 (0.0435) | −0.0569 (0.0450) |
| Bank ranking\(^3\) × cash flow × shock(2020) | 0.0298 (0.0466) | 0.0422 (0.0378) | −0.0123 (0.0292) |
| Bank ranking\(^1\) × cash flow × shock(2021) | −0.0125 (0.0730) | −1.56e-05 (0.0455) | −0.0124 (0.0567) |
| Bank ranking\(^2\) × cash flow × shock(2021) | −0.0170 (0.0516) | 0.0189 (0.0344) | −0.0359 (0.0384) |
| Bank ranking\(^3\) × cash flow × shock(2021) | −0.0377 (0.0504) | 0.0232 (0.0403) | −0.0610 (0.0373) |
| Bank fixed effects | Yes | Yes | Yes |
| Firm fixed effects | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes |
| Bank × year fixed effects | Yes | Yes | Yes |
TABLE 9  (Continued)

|                      | (1) Total Bank borrowing (normalized by debt) | (2) Short term Bank borrowing | (3) Long term Bank borrowing |
|----------------------|---------------------------------------------|-------------------------------|-------------------------------|
| Firm × year fixed effects | Yes                                         | Yes                           | Yes                           |
| Number of observations | 23,663                                      | 23,663                        | 23,663                        |
| $R^2$                | .658                                        | .598                          | .614                          |

Note: This table presents estimates with bank borrowings (normalized by a firm’s total debt) as the dependent variable. The definitions of the independent variables are the same as those in Tables 2 and 6. The estimated standard errors based on clustering across firms and banks are shown in parentheses.

*Significance at the 10% level.

**Significance at the 5% level.

***Significance at the 1% level.

Focusing on the estimation results of bank ownership, the estimated coefficients of shareholding ratio and the top 3 or 10 shareholders are positive and statistically significant at the 1% level. These findings suggest that banks offer more loans to firms if they are the main shareholders. This is consistent with the notion that main banks are likely to be the main shareholders of firms. The estimated coefficients of bank ownership × shock are statistically insignificant in all columns. These results do not support banks with large shareholdings, offering more loans to firms during the shock period.

In addition, we estimate the heterogeneous effects of cash flows on bank ownership. We add Bank Ownership$_{it}$, Bank Ownership$_{it}$ × Shock$_{t}$, and Cash Flow$_{it}$ × Bank Ownership$_{it}$ × Shock$_{t}$ to Equation (2). Table 12 presents the estimation results for these variables. We only show the estimated coefficients of the selected variables. The estimation results for bank ranking and cash flow are similar to those in Tables 4 and 8. The estimated coefficients of bank ownership × cash flow are negative and statistically significant at the 1% or 5% level. This suggests that banks offer loans to firms that decrease cash flows if banks are a major shareholder of borrowing firms. However, the estimation coefficients of bank ownership × cash flow × shock are statistically insignificant. In summary, the estimation results are driven by lending relationships and not by the large shareholding of banks.

FIGURE 1  Trend of the estimated coefficients of cash flow on total bank borrowings. This figure depicts the label graph of the estimated coefficients of cash flow on total bank borrowings by bank ranking and year. For this, we estimated the following equation:

$$
\text{Bank Borrowings}_{it} = \sum_{r=1,2,3} \gamma_{r} \text{Bank Ranking}_{it, r} + \sum_{r=1,2,3} \gamma_{r} \text{Bank Ranking}_{it, r-1} \times \text{Shock}_t + \sum_{r=1,2,3} \gamma_{r} \text{Bank Ranking}_{it, r-1} \times \text{Cash Flow}_{it} + \sum_{r=1,2,3} \gamma_{r} \text{Bank Ranking}_{it, r} \times \text{Cash Flow}_{it} \times \text{Year Dummies}_{it} + \epsilon_{it} + \delta_t + \theta_{it} + \tau_{it}
$$

Shareholding ratio is defined as the ratio of shareholdings of bank $j$ to total outstanding shares for firm $i$ in year $t$. Top 3 shareholders dummy equals 1 if bank $j$ is the top 3 shareholders for firm $i$ in year $t$. The top 10 shareholders dummy equals 1 if bank $j$ is the top 10 shareholders for firm $i$ in year $t$. The definitions of the other variables are the same as those in Equation (1).

Table 11 presents the estimation results for Equation (5). The estimation results using the shareholding ratio are shown in Columns (1) and (2), those using the top 3 shareholders dummy are shown in Columns (3) and (4), and those using the top 10 shareholders dummy are shown in Columns (5) and (6). In all tables, the estimation results of bank ranking and bank ranking × shock are similar to those in Tables 2 and 6. This suggests that banks with large lending shares offer more loans to firms during the shock period.

TABLE 10  Bank shareholdings by bank ranking

| Bank ranking | Shareholding ratio | Top 10 Mean | Top 3 Mean |
|--------------|--------------------|-------------|------------|
| 1st          | 0.0189             | 0.0000      | 0.0353     | 0.5685     | 0.1661     |
| 2nd          | 0.0093             | 0.0000      | 0.0170     | 0.2996     | 0.0370     |
| 3rd          | 0.0059             | 0.0000      | 0.0081     | 0.1734     | 0.0203     |
| 4th or later | 0.0024             | 0.0000      | 0.0000     | 0.0720     | 0.0098     |

Note: This table presents descriptive statistics for bank shareholding. The shareholding ratio is defined as the ratio of shareholdings of bank $j$ to total outstanding shares for firm $i$ in year $t$. Top 3 shareholders dummy equals 1 if bank $j$ is the top 3 shareholders for firm $i$ in year $t$, and the top 10 shareholders dummy equals 1 if bank $j$ is the top 10 shareholders for firm $i$ in year $t$.
### Table 11

| Dependent variable Proxy of bank ownership | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
|--------------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                            | Total bank borrowing (normalized by asset) | Shareholding ratio | Top 3 shareholders | Top 10 shareholders |
| Bank ranking\(^1\)                         |                      | 0.0487\(^{***}\)    | 0.0487\(^{***}\)    | 0.0532\(^{***}\)    | 0.0532\(^{***}\)    | 0.0501\(^{***}\)    |
|                                            |                      | (0.00231)           | (0.00232)           | (0.00235)           | (0.00235)           | (0.00252)           |
| Bank ranking\(^2\)                         | 0.0225\(^{***}\)    | (0.00117)           | (0.00117)           | 0.0247\(^{***}\)    | 0.0247\(^{***}\)    | 0.0229\(^{***}\)    |
|                                            | (0.00232)           | (0.00103)           | (0.00103)           | (0.00114)           | (0.00114)           | (0.00114)           |
| Bank ranking\(^3\)                         | 0.0125\(^{***}\)    | (0.000805)          | (0.000805)          | 0.0136\(^{***}\)    | 0.0136\(^{***}\)    | 0.0128\(^{***}\)    |
|                                            | (0.000742)          | (0.000742)          | (0.000791)          | (0.000791)          | (0.000791)          | (0.000791)          |
| Bank ranking\(^1\) × shock                 | 0.00405*            | 0.00448**           | 0.00381             |                      |                      |                      |
|                                            | (0.00233)           | (0.00201)           | (0.00236)           |                      |                      |                      |
| Bank ranking\(^2\) × shock                 | 0.00204*            | 0.00229**           | 0.00194*            |                      |                      |                      |
|                                            | (0.00114)           | (0.00101)           | (0.00115)           |                      |                      |                      |
| Bank ranking\(^3\) × shock                 | 0.000554            | 0.000729            | 0.000466            |                      |                      |                      |
|                                            | (0.000826)          | (0.000777)          | (0.000816)          |                      |                      |                      |
| Bank ranking\(^1\) × shock(2020)           | 0.00440**           | 0.00513**           | 0.00426**           |                      |                      |                      |
|                                            | (0.00202)           | (0.00164)           | (0.00208)           |                      |                      |                      |
| Bank ranking\(^2\) × shock(2020)           | 0.00258**           | 0.00293**           | 0.00261**           |                      |                      |                      |
|                                            | (0.00122)           | (0.00111)           | (0.00124)           |                      |                      |                      |
| Bank ranking\(^3\) × shock(2020)           | 0.000783            | 0.00109             | 0.000724            |                      |                      |                      |
|                                            | (0.00102)           | (0.000978)          | (0.00102)           |                      |                      |                      |
| Bank ranking\(^1\) × shock(2021)           | 0.00361             | 0.00373             | 0.00327             |                      |                      |                      |
|                                            | (0.00307)           | (0.00274)           | (0.00303)           |                      |                      |                      |
| Bank ranking\(^2\) × shock(2021)           | 0.00143             | 0.00157             | 0.00120             |                      |                      |                      |
|                                            | (0.00141)           | (0.00123)           | (0.00140)           |                      |                      |                      |
| Bank ranking\(^3\) × shock(2021)           | 0.000277            | 0.000321            | 0.000160            |                      |                      |                      |
|                                            | (0.000908)          | (0.000842)          | (0.000895)          |                      |                      |                      |
| Bank ownership                             | 0.328\(^{***}\)    | 0.328\(^{***}\)    | 0.0648\(^{**}\)    | 0.0648\(^{**}\)    | 0.0816\(^{***}\)   | 0.0816\(^{***}\)   |
|                                            | (0.0481)            | (0.0481)            | (0.00295)           | (0.00295)           | (0.00131)           | (0.00131)           |
| Bank ownership × shock                      | 0.00584             | 0.000153            | 0.000696            |                      |                      |                      |
|                                            | (0.0407)            | (0.00251)           | (0.00123)           |                      |                      |                      |
| Bank ownership × shock(2020)               | 0.0332              | 0.000563            | 0.00136             |                      |                      |                      |
|                                            | (0.0401)            | (0.00233)           | (0.00140)           |                      |                      |                      |
| Bank ownership × shock(2021)               | −0.0225             | −0.00094            | 0.0000248           |                      |                      |                      |
|                                            | (0.0530)            | (0.00371)           | (0.00143)           |                      |                      |                      |
| Bank fixed effects                         | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Firm fixed effects                         | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Year fixed effects                         | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Bank × year fixed effects                  | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Firm × year fixed effects                  | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Number of observations                     | 24,844              | 24,844              | 24,844              | 24,844              | 24,844              | 24,844              |
| \(R^2\)                                    | .624                | .624                | .619                | .619                | .622                | .622                |

Note: This table presents estimates with bank borrowings (normalized by a firm's total assets) as the dependent variable. The definitions of the independent variables are the same as those in Tables 2, 6, and 10. The estimated standard errors based on clustering across firms and banks are shown in parentheses.

*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.
| Dependent variable | (1) | (2) | (3) | (4) | (5) | (6) |
|--------------------|-----|-----|-----|-----|-----|-----|
| **Total bank borrowing (normalized by asset)** | | | | | | |
| Shareholding ratio | | | | | | |
| Bank ranking¹ × cash flow | −0.136*** | −0.136*** | −0.159*** | −0.164*** | −0.145*** | −0.145*** |
| (0.0296) | (0.0296) | (0.0321) | (0.0351) | (0.0295) | (0.0295) |
| Top 3 shareholders | | | | | | |
| Bank ranking² × cash flow | −0.0635*** | −0.0635*** | −0.0745*** | −0.0784*** | −0.0666*** | −0.0666*** |
| (0.0202) | (0.0202) | (0.0208) | (0.0219) | (0.0198) | (0.0198) |
| Top 10 shareholders | | | | | | |
| Bank ranking³ × cash flow | −0.0409** | −0.0409** | −0.0440** | −0.0458*** | −0.0429** | −0.0429** |
| (0.0171) | (0.0171) | (0.0173) | (0.0171) | (0.0171) | (0.0171) |
| Bank ranking¹ × cash flow × shock | −0.0672 | −0.0822** | −0.0549 | | | |
| (0.0425) | (0.0402) | (0.0454) | | | |
| Bank ranking² × cash flow × shock | −0.0428 | −0.0492* | −0.0372 | | | |
| (0.0288) | (0.0289) | (0.0287) | | | |
| Bank ranking³ × cash flow × shock | −0.00527 | −0.0101 | 0.000648 | | | |
| (0.0241) | (0.0244) | (0.0246) | | | |
| Bank ranking¹ × cash flow × shock(2020) | −0.137*** | −0.162*** | −0.126** | | | |
| (0.0545) | (0.0576) | (0.0565) | | | |
| Bank ranking² × cash flow × shock(2020) | −0.0489 | −0.0570 | −0.0430 | | | |
| (0.0369) | (0.0377) | (0.0369) | | | |
| Bank ranking³ × cash flow × shock(2020) | 0.00831 | 0.00690 | 0.0106 | | | |
| (0.0274) | (0.0271) | (0.0276) | | | |
| Bank ranking¹ × cash flow × shock(2021) | −0.0270 | −0.0385 | −0.0117 | | | |
| (0.0447) | (0.0465) | (0.0472) | | | |
| Bank ranking² × cash flow × shock(2021) | −0.0443 | −0.0458 | −0.0391 | | | |
| (0.0328) | (0.0342) | (0.0326) | | | |
| Bank ranking³ × cash flow × shock(2021) | −0.0291 | −0.0309 | −0.0201 | | | |
| (0.0319) | (0.0333) | (0.0329) | | | |
| Bank ownership × cash flow | −4.313*** | −4.313*** | −0.101** | −0.150** | −0.115*** | −0.115*** |
| (1.134) | (1.134) | (0.0390) | (0.0593) | (0.0385) | (0.0385) |
| Bank ownership × cash flow × shock | 0.429 | 0.0227 | −0.00502 | | | |
| (1.562) | (0.0582) | (0.0509) | | | |
| Bank ownership × cash flow × shock(2020) | 0.365 | 0.0985 | −0.0345 | | | |
| (1.813) | (0.0791) | (0.0637) | | | |
| Bank ownership × cash flow × shock(2021) | 0.595 | 0.0705 | 0.0112 | | | |
| (1.558) | (0.116) | (0.0476) | | | |
| Bank fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank × year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm × year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of observations | 23,957 | 23,957 | 23,957 | 23,957 | 23,957 | 23,957 |
| **R²** | .623 | .556 | .584 | .658 | .598 | .614 |

Note: This table presents estimates with bank borrowings (normalized by a firm's total assets) as the dependent variable. The definitions of the independent variables are the same as those in Tables 2, 6, and 10. The estimated standard errors based on clustering across firms and banks are shown in parentheses.

*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level.
4 | CONCLUSION

This paper investigates whether banks with close relationships with borrowing firms offer more bank loans to these firms during the shock caused by the COVID-19 pandemic using matched data. Firms increase credit needs to finance liquidity shortages caused by the shock, so banks increase loans to borrowers. According to the banking literature, banks offer liquidity insurance. We predict that banks that have close relationships with firms increase their bank loans to respond to the credit needs of these firms during the shock. We investigate this issue using bank–firm matched data over 4 years, including before and during the shock period. Using the matched data, we can control for several fixed effects, so we can extract the effects of relationships on bank loan supply during the shock period.

Our estimation results show that banks with the largest lending share for a firm increased their lending during the COVID-19 shock. In addition, if we focus on individual cash flow shocks, we show that banks with the largest lending share offered more bank loans to firms that experienced cash flow declines during the shock period. These effects are larger in 2020, which is the beginning of the COVID-19 shock. These results imply that banks that had close relationships with firms acted as liquidity providers to these firms during the COVID-19 shock, which is a sudden and unpredictable economic shock.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from Nikkei Inc. Restrictions apply to the availability of these data, which were used under license for this study. Data are available at https://www.nikkei.co.jp/needs/services/financial-quest/ with the permission of Nikkei Inc.

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ENDNOTES

1 The Bank of Japan sent the Tankan questionnaire to firms with 50 or more workers. One survey item concerns the business conditions of responding firms, with respondents selecting one option from these three: (1) favorable, (2) not so favorable, or (3) unfavorable. The DI of business conditions is defined as the percentage of firms selecting “favorable” minus the percentage of firms selecting “unfavorable.” See the website of the Bank of Japan for more detailed explanations of Tankan: https://www.boj.or.jp/en/statistics/tk/index.htm/ (Last accessed: March 2021).

2 LOOS is survey for senior loan officers at large Japanese banks concerning the loan market. Questions for “Demand for Loans” is that “How has demand for loans from borrowers (firms, local governments, and households) changed over the past three months apart from normal seasonal variations?” DI for demand for loans = (percentage of respondents selecting “substantially stronger” + percentage of respondents selecting “moderately stronger” × 0.5) – (percentage of respondents selecting “substantially weaker” + percentage of respondents selecting “moderately weaker” × 0.5). DI for demand for loans is 3 in October 2019 and 2 in January 2020 but increases to 14 in April 2020 and 59 in July 2020. See the website of the Bank of Japan for more detailed explanations of the DI for demand for loans: https://www.boj.or.jp/en/statistics/dl/loan/loos/index.htm/ (Last accessed: March 2021).

3 This is calculated using 373 Japanese manufacturing firms listed on the First Section of the Tokyo Stock Exchange during 1986.

4 We exclude trust accounts when we define top 3 or 10 shareholders.

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