Determinants and Effects of COVID-19 Business Support Programs: Evidence from a Survey to SMEs in Japan[†]

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Abstract

Using a set of survey and financial data for Japanese small- and medium-enterprises (SMEs), this paper examines the determinants and the causal effects of the business support programs provided by the Japanese government during the COVID-19 pandemic. With respect to the determinants we have the following three findings: First, firms were more likely to receive subsidized loans, grants, or subsidies if their sales growth decreased more during the pandemic, suggesting that funds flowed to firms that were adversely affected by the pandemic. Second, the likelihood that firms received funds was higher if their credit scores were lower or if they were classified as "zombies" and/or "low-return borrowers" before the pandemic, suggesting that the government programs also helped firms that had been under-performing before the pandemic. Third, firms were more likely to receive funds if their relationships with the main bank before the pandemic were stronger, suggesting the importance of bank relationships in firms' access to government programs. Regarding the causal effects, we have the following three findings: First, all the support programs increased cash holdings of user firms. Second, subsidized loans from private financial institutions lowered exit rates, while there is no evidence that the programs increased employment. Third, the user firms of government programs decreased credit scores and profit-to-sales ratio and increased the likelihood of being a zombie and/or a low-return borrower. Overall, our findings provide a cautionary tale on the aftermath of firms that used business support programs in times of a crisis.

JEL classifications: D22, D25, L52

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1. Introduction

To deal with the COVID-19 pandemic crisis, governments around the world have implemented various business support measures including tax grace, subsidies, subsidized loans, and credit guarantees.[1] In the U.S., for example, the government provided small- and medium-sized enterprises (SMEs) with loans on preferable conditions through private sector lenders (Paycheck Protection Program: PPP). In Japan, the government provided SMEs with subsidized loan programs, subsidies for employment adjustment, and other programs to prevent business failures and curb an increase in unemployment.

While these business support programs were likely to reduce business failures and unemployment, growing concerns have emerged concerning whether they support firms that temporarily face liquidity shortage, or they support firms that are not viable without support and reduce the exit of such nonviable firms. In the latter case, business support programs will retard economic restructuring, reduce efficiency in the resource allocation, and eventually lower aggregate productivity.

To shed lights on these concerns, we try to answer the following three questions. First, what type of firms were more likely to receive government support? Are firms that were more adversely affected by the pandemic and as such the main targets of the programs more likely to receive support? Alternatively, are firms with worse pre-pandemic performance more likely to receive government support? Specifically, are firms that were not viable without support from the government or banks, often called "zombies," before the pandemic more likely to receive support than healthy firms? If so, such programs have the risk of helping zombies survive and slowing economic restructuring. Second, did programs reduce firm exit and increase employment? This question addresses whether programs achieved their goals of keeping business afloat and curbing an increase in unemployment. Third, did surviving supported firms perform better than those that were not supported? The second and third questions are concerned with causal effects, and hence distinct from the first question of who received support.

To answer these questions, we use firm-level data from Japan, which is suitable for the following three reasons. First, the Japanese government provided various large-scale support programs as we describe in

[1] See OECD (2020, 2021) for the surveys of government financial support programs in OECD countries.

Section 2. Second, the Japanese economy was burdened with zombies in the late 1990s and early 2000s, which have led to serious concerns about recurrence of zombie problems amid the pandemic.[2] Third, we have rich data from a unique survey on Japanese firms that contain information on the use of each program.

Specifically, we use a survey on Japanese SMEs conducted by the Research Institute of Economy, Trade, and Industry (RIETI) in November 2020.[3] The survey contains information on whether the firm applied for and received each of the major business support programs in Japan including (1) special loan program by the government-affiliated financial institutions, (2) special loan program by the private financial institutions, (3) grants and subsidies for continuing businesses, and (4) subsidies for employment adjustment. We match data from the survey with firm-level data from the Tokyo Shoko Research's (TSR) database that contains information on the firm attributes including credit scores and financial statement indicators. Further, using the information, we identify zombie firms and low-return borrowers using the definitions provided in previous studies (Caballero, Hoshi, and Kashyap (2008) and Fukuda and Nakamura (2011) for zombie firms and Bank of Japan (2018) for low-return borrowers).

Using the dataset, we first conduct the logit estimation for receiving funds from each support program. The results show that firms that decreased sales more during the pandemic were more likely to receive funds from the support programs. This result indicates that severely affected firms tended to use the programs. At the same time, firms that had low credit scores before the pandemic were also more likely to obtain funds from the support programs. Moreover, zombies and low-return borrowers, irrespectively of the definition, were more likely to use the programs. These results indicate that firms who had performed worse and may not have been viable without support from banks before the pandemic obtained funds from the programs. An additional finding is that firms were more likely to receive funds if their relationships with the main bank before the pandemic were stronger, suggesting that close bank relationships play an important role in firms' access to government programs.

Next, to examine the effects of programs on firms' liquidity position, firm exit, employment, and

[2] See Caballero, Hoshi, and Kashyap (2008) and Peek and Rosengren (2005) about the causes and consequences of zombies in Japan in the 1990s.
[3] See Uesugi et al. (2021) for the details of the survey.

performance, we conduct propensity-score matching and difference in differences (PSM-DID) analyses over the period from 2019 (pre-pandemic year) to 2021 (post-pandemic year). Our results show that all the support programs increased the amount of firms' cash holdings. The results also indicate that special loan programs provided by private banks decreased the likelihood of firm exit, although the other three programs did not. On the other hand, none of the four programs including the subsidies for employment adjustment significantly increased employment. These results indicate that the extent to which the programs achieved their goals was limited to firms' survival. As for the performance of surviving firms, the results indicate that all the programs worsened credit scores and two of them (preferential loans from GFIs and subsidies for employment adjustment) decreased profit-to-sales ratios. Moreover, all the programs significantly increased the likelihood of a firm's being zombie or low-return by at least one of the four zombie or low-return criteria we employ. The programs are likely to have a serious side effect of deteriorating surviving firms' performance at least in the short run, although the long-run effects are yet to be seen.

This study is closely related to the literature that assesses COVID-19 business support programs.[4] Studies on PPP in the US obtain mixed results about its quantitative effects on employment and business survival. Granja et al. (2020) show that many firms used the loans to make non-payroll fixed payments and increased savings. Chetty et al. (2020) also present evidence for small effects. They show that PPP loans increased employment at small businesses by only 2%, implying a cost of $377,000 per job saved. On the other hand, Doniger and Kay (2022) find that the PPP was highly effective in preventing job losses particularly among the self-employed and in very small firms and that a ten-day delay in approving PPP loans resulted in a substantial and persistent increase in unemployment. Barlett and Morse (2020) show that receipts of PPP funds increased the firms' subjective survival probability by 20.5%, but only for microbusinesses.

Importantly, many studies on PPP find that banks play an important role in mediating program targeting. Granja et al. (2020) find that some funds initially flowed to regions that were less adversely affected by the pandemic and banks' exposure to PPP was determined by ex-ante bank characteristics, such as greater

[4] Apart from the assessment of specific programs, Gourinchas et al. (2020) use pre-pandemic firm-level data from 17 countries in 2017 to find that the failure rate of SMEs would increase by nearly 9 percentage points without government support.

labor capacity to process loans and pre-existing SBA relationships. Balyuk, Prabhala and Puri (2021) show that although smaller firms were less likely to gain early PPP access, prior lending relationships between small banks and firms attenuated this effect. Li and Strahan (2021) also show that bank relationships help firms access PPP funds. Joaquim and Netto (2021) show both theoretically and empirically that banks distorted the allocation of PPP funds toward firms with more pre-pandemic debt and those less affected by the COVID-19 crisis.

Some studies assess business support programs other than PPP. Boddin, D'Acunto and Weber (2020) examine the government-guaranteed loans that the German government introduced during the pandemic and show that firms that applied for government-guaranteed loans were more likely to display zombie features before the pandemic.[5]

As for the programs in Japan, Morikawa (2021) uses a survey on the use of support programs and finds that firms that had lower productivity before the pandemic were more likely to use them. Hoshi, Kawaguchi and Ueda (2022) use a different survey to find that firms that had lower credit scores before the COVID-19 pandemic were more likely to apply for and receive the subsidies and concessional loans. They further examine whether zombies based on the Caballero, Hoshi, Kashyap (2008) criterion were more likely to receive them and find no significant difference between zombies and non-zombies. Uesugi et al. (2022) use the same survey that we use in this current paper and find that firms with lower pre-pandemic credit scores and firms that received government-guaranteed loans during the Global Financial Crisis were more likely to apply for various programs.

This study has a unique feature compared to the literature that assesses business support programs in two major ways. First, we examine the effects of receiving program funds on firm exit and survivors' performance as well as employment. As far as we know, few studies have examined this issue despite its importance given the concern for side effects that the programs let inefficient or non-viable firms survive.[6]

[5] Following Schmidt et al. (2020), Boddin, D'Acunto and Weber (2020) define a zombie as a firm with negative returns on assets, negative change in total assets (proxy for investments), and debt servicing capacity below 5% measured as net income over loans and liabilities.

[6] Barlett and Morse (2020) examine the effects of PPP funds on firms' subjective probability of survival.

Second, we define zombies and low-return borrowers and examine whether they were more likely to receive support and whether the support increased the likelihood of becoming a zombie or low-profit borrower. The only studies that examine the role of zombies in receiving Covid-19 government supports are Boddin, D'Acunto and Weber (2020) for Germany and Hoshi Kawaguchi and Ueda (2022) and Uesugi et al. (2022) for Japan. Again, these studies examine only whether zombies were more likely to receive funds. One additional unique feature of this study is that we examine the role of banks in receiving program funds using information on the closeness of firm-main bank relationships.

The remainder of the study is structured as follows: Section 2 provides a brief overview of the business support programs in Japan. Section 3 then describes our data, variables, and the empirical methodology. Next, Section 4 reports the results. Section 5 summarizes the results and concludes.

2. Institutional background for support programs for SMEs during the COVID-19 pandemic

The Japanese government has provided a number of support programs to assist firms that faced financial distress since the start of the pandemic. These programs include special-term loans, subordinated loans, grants, subsidies, moratoriums on debt repayment, the grace of tax and social insurance fee payments, and the protection of small subcontractors. Some measures such as tax payment grace and subordinated loans target firms of all sizes, while some others aim only for assisting SMEs. Among the measures that are designed for SMEs we specifically focus on special-term loans, grants, and subsidies for our analysis, since the size of fiscal disbursements for these measures was quite sizable. In below, we explain each one of them in detail.

2.1. Special loan programs

The government has engaged in two special loan programs related to COVID-19: The first program is for loans originated by the government-affiliated financial institutions (hereafter GFIs) and the second one is for loans originated by private financial institutions and backed by government guarantees and subsidies.[7]

[7] There are several studies that examine effectiveness of the loans by the GFIs and that of government guaranteed loans in Japan. See Uesugi, Sakai, Yamashiro (2010) and Ono, Uesugi, and Yasuda (2013) for the guaranteed loans and Uesugi, Uchida, and Mizusugi (2016) and Ogura (2018) for loans by the GFIs.

2.1.1. Loans by GFIs

The GFIs extend loans with preferential terms to SMEs. There are three GFIs that are in charge of these loans: the Japan Finance Corporation, the Shoko Chukin Bank, and the Okinawa Development Finance Corporation.

For SMEs whose sales are damaged by the pandemic, these GFIs extend low-interest rate unsecured loans. They label these loans as "the special loans to deal with the COVID-19 infections." Eligibility conditions for firms to apply for these special-term loans are their sales dropped by no less than 5%. The firms that were approved for these unsecured loans receive a discount of the interest rate for the first three years.[8] Further, for firms whose sales are most severely damaged, these institutions provide "de facto interest-free" unsecured loans.[9] Eligibility conditions for these interest-free loans are firms' sales dropped by no less than 5% (micro sole proprietorships), 15% (for micro corporations) or 20% (for SMEs). Note that SMEs that are not eligible for these special loans with preferential terms can still apply for the normal loans provided by these GFIs.

2.1.2. Private bank loans backed by guarantees and subsidies

Private financial institutions originate unsecured SME loans with preferential terms in response to the pandemic. The government incentivizes private institutions to extend these loans by providing loan guarantees and subsidies for interest payments and guarantee fees. The coverage ratio of loan guarantees in each loan contract is 100% in most cases. Guarantee fees and interest payments are fully subsidized for all micro proprietorships and for SMEs whose sales dropped by no less than 15%.[10] Half of the guarantee fees are subsidized for SMEs whose sales dropped by no less than 5%, while these firms receive no interest rate discount. The government labeled this program as "de facto zero-interest zero-collateral loans" and promoted its use.[11] Note that SMEs that are not eligible for these guaranteed loans with preferential terms can still apply for the normal guaranteed loans.

[8] The margin of the discount from the standard interest rate is 0.9%. Note that this standard rate is already lower than the average interest rate set by private financial institutions by about 0.3% to 0.4%. For a detailed comparison of interest rates between the government and private banks in Japan, see Uesugi, Uchida, and Iwaki (2020).

[9] These loans are interest-free for the first three years. They are called "de facto interest-free," because borrower firms first make interest payments to the government banks and then get reimbursed the amount by the Organization for Small and Medium Enterprises and Regional Innovation (SMRJ), one of the government agencies in charge of implementing SME policies.

[10] Interest payments are subsidized for the first three years in a loan contract and guarantee fees are subsidized for the enter contract period.

[11] It is called as "de facto zero interest rate" because in some cases an SME makes non-negative interest payments to a bank but later the local government reimburses the amount to the SME.

A few additional remarks on these two special loan programs are in order. First, the GFIs started this special loan program in mid-March 2020, while private financial institutions started receiving applications from the beginning of May in the same year. The difference in timing when each of the loan programs was first introduced may have induced SMEs that were most badly in need of liquidity to rush to the desk of the GFIs instead of to those of the private institutions. Second, upon extending these special loans of each type, certain restrictions on the repayment of existing loans apply. The GFIs do not allow borrower firms to repay existing private bank loans at the expense of newly provided special-term government bank loans. In contrast, in the special loan program by private financial institutions, firms are allowed to repay existing guaranteed loans with new special loans under certain conditions.[12] The difference in the treatment of existing loans may lead to a different extent of additionality (the extent of a net increase in the loan amount outstanding for a borrower firm that uses the special loan programs) between government loan users and users of private loans.

2.2. Grants and subsidies

In this section and the section that follows, we focus on four different grants and subsidies to financially assist SMEs that were adversely affected by the pandemic: (1) grants and subsidies for continuing businesses; (2) grants for rent payment; (3) subsidies for employment adjustment; and (4) support money in compensation for business closure. The first three have been introduced by the central government, while local governments have provided the fourth one.

First, by providing grants for continuing businesses, a one-time payment of 2 million yen to corporations and 1 million yen to sole proprietorships, the government seeks to financially support them to sustain their businesses. Eligibility conditions for firms to apply for the grants are their monthly sales dropped by no less than 50%. The business continuity subsidies, which provide a one-time payment of 1 million yen or 0.5 million yen to a micro business, aim for supporting its specific activities such as sales promotion to combat the pandemic.[13] There are no specific eligibility conditions for the subsidies.

[12] The repayment of existing non-guaranteed private bank loans is prohibited in both GFIs' and private financial institutions' special loan programs. However, the finding in Ono, Uesugi, and Yasuda (2013) suggests that the repayment of existing non-guaranteed loans might have occurred at the expense of guaranteed loans under the Emergency Credit Guarantee Program during the Global Financial Crisis.

[13] Note that there are some other types of business continuation subsidies that are designed to support firms' activities unrelated to surviving the pandemic.

Second, by the grants for rent payment the government reimburses firms' rents up to 6 million yen to an SME or up to 3 million yen to a sole proprietorship. Eligibility conditions for firms to apply for the grants are the firms' monthly sales dropped by no less than 50% or their three-month sales dropped by no less than 30%.

Third, there are subsidies for employment adjustment during the normal times. But the government augmented the scheme by increasing the subsidy coverage in response to the pandemic. The subsidies cover a firm's cost of paying furloughed workers.[14] To SMEs that do not lay off any employees, the subsidies pay 100% of the furlough payment, while the ratio reduces to 4/5 for SMEs that lay off some employees.

Last but not least is the support money provided by local governments. Local governments, especially those located in areas where infections were wide-spread such as Tokyo and Osaka, have spent a substantial amount for compensating firms' forgone revenues caused by their closures. These measures have been adopted since the government first declared the State of Emergency in April 2020. The central government financially supported the local government expenses by the grant for regional development. These support money schemes differ substantially in their contents across prefectures and cities but in general provide a payment to shops and restaurants the amount proportional to the duration of business closures.[15]

There are two additional notes on these grants and subsidies. First, the starting time is different across these measures. The government started receiving applications for the grants for continuing businesses from May 1, 2020 and for the rent payment grants from July 14 of the same year. It also announced increasing the coverage of the employment adjustment subsidies to the level explained in the above paragraph on April 23, 2020. For the support money provided by the local governments, the Tokyo metropolitan government started receiving applications on April 23 and disbursing money on May 7. From the above information, we expect that the government received the largest number of applications for the three grants and subsidies in May 2020: The grants for continuing businesses; the employment adjustment subsidies; and the support money in compensation for the business closure. In contrast, applications and disbursements may have lagged behind

[14] In addition to the furlough payment, the government also covers the firm's expense on off-the-job trainings.
[15] For example, the Hokkaido prefectural government gave as cooperation money of 300 thousand yen to corporations, 200 thousand yen to sole proprietorships, and 100 thousand yen to restaurants that temporarily shut down or shorten their business hours during the period of emergency during the fiscal year 2020.

for the rent payment grants.[16] Second, among the four measures, the employment adjustment subsidies differ from the other three programs in that the amount of disbursement is proportional to firm's employment size. In contrast, the amount of money paid by the other three programs is fixed and does not change according to the number of employees within a firm.

2.3 Size of loans, grants, and subsidies provided during the pandemic

There was a massive amount of loans being extended by the GFIs and the private financial institutions to SMEs during the pandemic. The total amount of loans for SMEs originated from the start of the pandemic to the end of June 2021 was 52.2 trillion yen, which is slightly less than 20% of the total amount of SME loans outstanding in Japan. Among them, the GFIs extended 16.3 trillion yen of loans which include de facto interest-free unsecured loans and other unsecured loans. Meanwhile, the private financial institutions provided 35.9 trillion yen of guaranteed loans, of which 23.4 trillion yen was for de facto zero-interest zero-collateral loans.

Also, a substantial amount of budget was spent for the grants and subsidies during the pandemic. The largest fiscal expenditure among the four policy measures by the end of June 2021 was made for the grants for continuing businesses, which was 5.5 trillion yen at the point when the program concluded. It was followed by the employment adjustment subsidies, which spent 2.9 trillion yen by the end of March 2021. The rent payment grants had disbursed 0.9 trillion yen by the end of receiving applications on February 15, 2021. It is not clear how much has been spent for the support money programs by local governments. But we may guess the maximum amount being spent for this purpose by looking at the budget provided by the central government to local governments for regional development. Out of the total of 4.5 trillion yen provided by the central government in fiscal year 2020, the local governments spent 1.4 trillion yen for supporting local businesses. We guess a substantial portion of this 1.4 trillion yen was used for the compensation money for the business closures during the pandemic period.

3. Data, variables, and empirical approach

[16] These predictions are actually consistent with what we found in the survey which asked firms the timings of applying for the grants and subsidies. In the survey, the largest numbers of firms applied for the three programs (the grants for continuing businesses, the employment adjustment subsidies, and the support money for business closure) in May, while it was September or later when the largest number of firms applied for the rent payment grants.

3.1. Data

The data used in this study are mainly taken from the "Survey on the Status of Firms under the COVID-19 Pandemic," which is the original firm survey conducted by the Research Institute of Economy, Trade and Industry (RIETI) in November 2020, and referred to as the "RIETI survey" hereafter. In addition, we use firms' financial data taken from the database of the Tokyo Shoko Research (TSR), a major credit research firm in Japan. The RIETI survey was sent to 20,000 firms. The selection procedure for these firms are as follows. First, we selected firms that responded to one of the past RIETI surveys conducted in February 2008, February 2009, and October 2014 and operated businesses as of November 2020. The number of these firms are 8,310. Next, we chose 11,690 firms from the TSR database so that the industry composition of the sample firms would be close to that of the 2016 Economic Census for Business Activity conducted by the Ministry of Internal Affairs and Communications, and the distribution of firm size in terms of the number of employees would be close to that of past RIETI surveys. We targeted corporations and did not include proprietorships. We believe that the sample of the RIETI survey is fairly close to the distribution of Japanese corporations, although it is tilted toward larger firms compared to the sample of the Economic Census.

The number of respondent firms to the RIETI survey is 4,718 for a response rate of 23.6 percent. The response rate is somewhat lower for firms in real estate industry, accommodations, eating and drinking services and for larger firms with the number of employees more than 100. [17] Among them, we exclude 25 firms for which we cannot obtain the basic characteristics (e.g., industry classification code). As a result, we have a maximum of 4,693 firms for the empirical analysis, although the number of observations differs depending on additional sample selection criteria and the number of missing observations for dependent variables we use in our estimations, which we explain below.

The RIETI survey asked a variety of issues with respect to business conditions (e.g., growth rate of sales) during the COVID-19 pandemic and how firms responded to the pandemic in terms of employment, investment, financing, and so on. Most importantly for this paper's analysis, the survey asks whether firms used various business support programs during the COVID-19 pandemic, which we outlined in Section 2.

[17] For details of the comparison between the characteristics of the sample firms (20,000 firms) and respondent firms (4,693 firms) in the RIETI survey, see Uesugi et al. (2021).

3.2. Key variables

In this subsection, we explain how we constructed the key variables for our analysis from the RIETI survey and TSR database. The definitions of variables used in our analyses and their data source are presented in Table 1.

3.2.1 COVID-19 business support programs

Using the RIETI survey, we construct dummy variables that identifies whether firms received funds by the COVID-19 business support programs. The RIETI survey asked whether and when firms considered applying and actually applied for each business support programs during the period February– November 2020. In addition, the survey asked whether and when firms received funds from the programs. Table 2 shows the result of these questions. There were 8 business support programs asked in the survey: (1) Special loan program by the GFIs, (2) other loan programs by the GFI, (3) special loan program by the private financial institutions, (4) other public guaranteed loan programs, (5) grants and subsidies for continuing businesses, (6) support money in compensation for business closure, (7) subsidies for employment adjustment, and (8) grants for rent payment. Table 2 shows that the programs that were most widely used in terms of the number of recipient firms are (3), (5), (7), and (1). Therefore, in our estimations below, we focus on these four programs and construct $Recieve_i_k$, a dummy variable indicating whether a firm i received funds from the program k. Table 2 also shows that the number of firms that applied for but did not obtain funds are very small. This suggests that whether firms received funds from the COVID-19 business support programs are mostly determined by whether they had applied for these programs and are thus demand-driven.

3.2.2 Measures for firm performance and firm-bank relationship

Next, to investigate the characteristics of firms that received funds from the COVID-19 business support programs, we construct following variables to measure the performance of respondent firms. First, to measure how firms were adversely affected by the COVID-19 pandemic, we use the minimum of the year-on-year monthly sales growth during the period February–November 2020, which we denote as $MinSalesGrowth2020$. The RIETI survey asked gross sales of each month between February and August and of the period from September to the time that firms responded to the survey in 2020 in comparison with the

same month/period in the previous year, 2019. The survey asked respondent firms to report the values of gross sales by assuming that the values in 2019 is 100. For example, if a firm's year-on-year sales growth in February 2020 is −10 percent, then the survey asked firms to report 90. The mean of gross sales in the RIETI survey was 101.6 in February, hit bottom in May at 86.3, and gradually recovered to 91.7 in the period after September. Hoshi, Kawaguchi, and Ueda (2022) constructed a similar variable using their own firm survey and reported that the year-on-year sales growth was −0.002 in February, −0.141 in May, and −0.076 in September. Their results are basically comparable to ours.

Second, to examine whether receiving funds from the business support programs is correlated with the pre-pandemic firm performance, we use firms' TSR credit score in 2019 (i.e., before the COVID-19 pandemic), $Score2019$. TSR credit score ranges from 0 to 100 points and a higher score indicates greater creditworthiness. TSR credit score is widely used as a proxy for firms' performance in empirical studies (Miyakawa, Miyauchi, and Perez, 2017; Miyakawa and Shintani, 2020), and is also used in Hoshi, Kawaguchi, and Ueda (2022). The mean of $Score2019$ for firms that responded to the RIETI survey is 52.0, which is lower than the mean (54.3) in Hoshi, Kawaguchi, and Ueda (2022).

In addition to firm performance measures, we create a variable which measures the intimacy of firms' relationships with their main banks ($ExtentRelationship$) to investigate whether firm-bank relationships help firm's access to government-subsidized lending (Li and Strahan 2021). We define main bank(s) of a firm as the bank that has the largest loans outstanding to the firm or the bank that has the closest relationship with the firm as of 2019. We construct this variable by counting the number of choices a firm responded "yes" to the question in the RIETI survey regarding qualitative characteristics of firm-main bank relationships. Five choices include: (1) the bank recognizes your firm's unnoticed strength; (2) the bank provides consultation services to your firm in addition to loans; (3) the bank provides useful information and assistance on managerial issues other than financing; (4) the bank points out your firm's managerial problems and gives advice on how to deal with them; and (5) the bank maintains a close relationship with your firm in general. Hence, $ExtentRelationship$ takes values between 0 and 5. The mean of $ExtentRelationship$ is 1.8.

3.2.3 Alternative firm performance measures: the share of zombie firms and low-return borrowers

As alternatives to the TSR credit score which measures pre-pandemic firm performance, we construct dummy

variables which represents whether firms received support from financial institutions and/or governments before the COVID-19 pandemic. Specifically, we use empirical strategies to identify "zombie" firms by Caballero, Hoshi, and Kashyap (2008) (hereafter CHK) and by Fukuda and Nakamura (2011) (hereafter FN) and "low-return borrowers" by the Bank of Japan (2018) (hereafter BOJ). The exact definitions of zombie firms / low-return borrowers based on these criteria are provided Table A1 in the Appendix.

CHK identified zombie firms as the firms that survive by receiving subsidized credit from financial institutions and bond investors in the sense that the firm's interest payment is less than the minimum required interest payment (or equivalently, the borrowing interest rate is lower than the most preferential interest rate). FN pointed out the possibility of two types of statistical errors when using the CHK's criterion. The first is the possibility that a healthy firm is identified as a zombie even though it has not received any subsidized credit. To avoid the first type of error, FN proposed "profitability criterion," which restricts zombies to those firms whose return-on-assets (ROA) is below the most preferential interest rate. The second is the possibility that an unhealthy firm is identified as a non-zombie even though it has received subsidized credit. For example, a firm may obtain "evergreening loans" whose interest rate is higher than the most preferential interest rate. To avoid this second type of error, FN proposed "evergreen lending criterion" so that unprofitable and highly leveraged firms that increased their external borrowings are identified as zombies.

On the other hand, the BOJ defined low-return borrowers as firms whose financial condition are relatively poor, and for which the bank sets the lending rate at a lower level relative to the firm's credit risk. To identify low-return borrowers, BOJ set two criteria. First, the ROA criterion (hereafter BOJ_ROA) requires that the firm's operating ROA is below the median of the distribution of all firms and its borrowing interest rate is lower than that for the most creditworthy firms in the ROA distribution (i.e., the firms in the top 10-percentile). Second, the leverage criterion (hereafter BOJ_Leverage) requires that the firm's financial leverage (liabilities-to-total asset ratio) is above the median of the distribution of all firms and its interest rate is lower than the creditworthy firms in the financial leverage distribution (i.e., the firms in the bottom 50-percentile). While BOJ defined a low-return borrower as one that meets either of the ROA criterion and the leverage criterion for two consecutive years, in this paper, we use these two criteria separately.

BOJ argues that low-return borrowers are not necessarily zombie firms that cannot survive without subsidized credit. However, in our analysis, we use the BOJ's criteria to identify low-return borrowers as

alternative measures for the CHK and the FN criteria to identify zombie firms because the BOJ's identification strategy is somewhat different from the CHK's and the FN's. That is, while the CHK and the FN criteria define zombie firms based on whether the borrowing interest rate is below the most preferential interest rate, the BOJ defines low-return borrowers based on whether the borrowing rate is below that of the firms with high profitability and creditworthiness in the same year. The difference between the CHK and the FN criteria using the most preferential interest rate and the BOJ's criteria using the borrowing rate of healthy firms may be important because the short-term and the long-term prime rate, which are used in the CHK and the FN, may no longer be valid for calculating the most preferential interest rate. That is, the short-term and the long-term prime rate may not be "extremely advantageous for the borrower" (CHK). For example, in December 2019, short-term and long-term prime rate is respectively 1.475% and 0.95%. Meanwhile, the average contract interest rate on newly issued loans by private banks is 0.67% for short-term loans and 0.73% for long terms and both are well below the prime rates.

Figure 1 shows the percentage share of zombie firms and low-return borrowers from 1990 to 2021 using the sample of firms who responded to the past (i.e., 2008, 2009, and 2014) and the current (i.e., 2020) RIETI surveys. The shares of zombie firms using the CHK and the FN criteria increased from 1990 to 1995–1996 and then declined until the mid-2000s. The share then began to rise again for both criteria until 2009. The subsequent changes in the share of zombie firms differed between the CHK and the FN criterion. In the case of the CHK criterion, the share of zombie firms continued to rise after 2009, reaching at 37% in 2019 (i.e., before the onset of the COVID-19 pandemic). The share of zombie firms using the CHK criterion in 2019 is comparable to that of the late 1990s, the period during which the problem of banks' bad loans and firms' excessive debt was severe. In contrast, the share of zombie firms using the FN criterion declined after 2009 and reached at 11% in 2019, which is the lowest level in the past 30 years. The reason behind the discrepancy between the share of zombie firms using the CHK criterion and that using the FN criterion is likely to be the first type of statistical error pointed out by FN: more and more healthy firms are being identified as zombies. In 2020–2021 during which the COVID-19 pandemic affected Japanese firms, both the share of zombie firms using the CHK criterion and that using the FN criterion increased.

The share of low-return borrowers using the BOJ_ROA criterion is less volatile over time than the share of zombie firms using the CHK and FN criteria, while the volatility of the share of low-return borrowers

using the BOJ_Leverage is similar to that using the CHK and the FN criteria. It is noteworthy that the shares of low-return borrowers by the BOJ_ROA and the BOJ_Leverage criteria increased during 2013–2016. In 2020 and 2021, the share of low-return borrowers based on the BOJ_ROA criterion is basically the same as it was in 2019, while that on the BOJ_Leverage criterion declined. These contrast with the share of zombie firms using the CHK and the FN criteria in 2020 and 2021, which exhibited an increase during the COVID-19 pandemic.

3.3. Empirical approach

3.3.1. Determinants of receiving business support programs

We first estimate the logit model to examine the characteristics of firms that received funds from the COVID-19 business support programs and investigate whether the funds were disbursed to firms that were more adversely affected by the COVID-19 pandemic and/or to firms that were financially unsound before the onset of the COVID-19 pandemic. In our estimations below, we restrict our sample to firms that met the eligibility conditions for each program, such as the extent of the decline in sales.[18] In addition, we restrict our sample to firms that considered applying for the programs before August 2020, i.e., firms that had enough time to obtain funds at the time 2020 RIETI survey was conducted. As a result, the numbers of observations that received funds from the programs are reduced compared to those in Table 2. Summary statistics of variables used in our estimations are presented in Table 3. The mean values for the key variables presented in this table are somewhat different from those reported in Section 3.2 because of this sample selection procedure. Note here that we do not cut off or winsorize extreme values for these variables in the table.[19]

Specifically, we first estimate the following logit model as a baseline,

$$\Pr(Receive_i_k = \psi\left(\alpha + \beta_1 MinSalesGrowth2020_i + \beta_2 Score2019_i + \mathbf{X_i \gamma_{1i}} + \mathbf{Z_j \gamma_{2j}}\right), \qquad (1)$$

where $\psi(\cdot)$ represents the cumulative density function of the logistic distribution. As noted, $Receive_i_k$ is

[18] Specifically, based on our discussions in Section 2, we set the following sample selection criteria. First, we restrict our sample firms to those whose monthly year-on-year sales in February–September 2020 declined equal to or more than 20% (special loan program by the GFIs), 15% (special loan program by private financial institutions), 50% (grants and subsidies for continuing businesses), and 5% (subsidies for employment adjustment). Second, we restrict our sample firms to those whose number of employees is equal to or less than 300 employees (special loan programs by the GFIs and private financial institutions) and 20 employees (grants and subsidies for continuing businesses) as of either 2020 or 2019.

[19] We do not cut off or winsorize these values in the estimations we will present their results in Section 4, either.

a dummy variable that represents whether firm *i* received funds from the program *k* in 2020, and we focus on the following business support programs: special loan program by GFIs ($Receive_GovLoan$), special loan program by private financial institutions ($Receive_PrivateLoan$), grants and subsidies for continuing businesses ($Receive_GrantContinue$), and subsidies for employment adjustment ($Receive_SubsidyEmp$).[20]

Regarding the effect of key variables on receiving program, we expect $\widehat{\beta_1}$ to have a negative sign if funds were disbursed to firms that experienced significant drop in sales during the pandemic ($MinSalesGrowth2020$).. We expect $\widehat{\beta_2}$ to have a negative sign if funds were more likely to be disbursed to poorly performing firms well before the COVID-19 pandemic ($Score2019$). By comparing the sign and the marginal effect estimates of $\widehat{\beta_1}$ and $\widehat{\beta_2}$, we examine whether the business support programs for COVID-19 hit the "target."

$\mathbf{X_i}$ denote additional control variables at the firm level, and we use log of a firm's sales amount ($lnSales$) and log of a firm's number of employees ($lnEmployment$) in 2019 to control for firm size, and a firm's current ratio in 2019 ($CurrentRatio$) to control for a firm's liquidity position before the pandemic. We expect that firms with a lower current ratio were more likely to fall into liquidity shortage, and thus were more likely to receive funds. Finally, $\mathbf{Z_j}$ denote prefectural-level variables to capture the effects of the COVID-19 pandemic on prefecture *j* in which a firm is located. We use the extent of an increase in the ratio of people staying at home rather than going out in prefecture *j* in May 2020 ($StayHome$). This variable is created by Takayuki Mizuno at the National Institute of Informatics (http://research.nii.ac.jp/~mizuno/). Similar to $MinSalesGrowth2020$, we expect that firms were more likely to receive funds if they were located in a prefecture where the adverse effect of the COVID-19 pandemic was greater.

As our second specification, we add $ExtentRelationship$ to Equation (1) and examine whether firm-bank relationships are beneficial for receiving government-subsidized loans, grants, and subsidies. We expect that the coefficient on $ExtentRelationship$ has a positive sign if intimate firm-bank relationships help firms' access to the COVID-19 business support programs.

[20] The estimation results are qualitatively very similar if we use a dummy variable that represents whether firms *applied* for the business support programs instead, presumably because the number of firms that were declined their applications were very small (see Table 2). Uesugi et al. (2022) examines the determinants of the applications and the denial of the COVID-19 business support programs.

As our third specification, we estimate the following logit model,

$$\Pr(Receive_{ik}) = \psi\big(\alpha + \beta_1 MinSalesGrowth2020_i + \beta_3 Zombie/LowReturn2019_i + \mathbf{Z_j}\boldsymbol{\gamma_{2j}}\big), \quad (2)$$

where the dummy variable $Zombie/LowReturn2019_i$ represents whether firm i was categorized as the zombie firm / low-return borrower in 2019 using the CHK ($Zombie_chk$), the FN ($Zombie_fn$), the BOJ_ROA ($LowReturn_roa$), and the BOJ_Leverage ($LowReturn_leverage$) criteria. Considering that these measures for zombie/low return status are constructed from information on a firm's ex-ante performance and dependence on external finance, we replace these zombie/low return variables with the explanatory variables on a firm's attributes before the pandemic. That is, we exclude $Score2019$, $lnSales$, $lnEmployment$, $CurrentRatio$, and $ExtentRelationship$ from the estimation when we include the zombie/low return status variable in equation (2). Note that we keep the variables on the firm's sales growth amid the pandemic (i.e., $MinSalesGrowth2020$) and on the extent of shocks at the prefecture-level (i.e., $StayHome$) in the estimation. If $\widehat{\beta_3}$ is significantly positive, it indicates that firms that received support from financial institutions before the pandemic were more likely to receive funds from the COVID-19 business support programs and suggests that these firms repeatedly relied on assistance from financial institution and/or governments.

3.3.2. Treatment effects of business support programs

Next, to examine the effectiveness of COVID-19 business support programs in reducing business failures and unemployment and improving recipient firm's performance, we conduct PSM-DID analysis. The procedure is as follows. First, based on logit estimations in the previous subsection, we attach a propensity score to each observation. Then, for each treatment observation (i.e., firm that received funds from a particular program), we identify matched observations from the subsample of non-recipient firms. The matched observations are those that have the "closest" propensity scores to a particular treatment observation and are labeled control observations. There are several matching algorithms to find the "closest" control observations, and we employ the nearest neighbor matching. Finally, we compare outcome variables for the treatment group and the control group to estimate the average treatment effect (ATE) using difference-in-differences (DID) approach. That is,

for each treatment and matched control firm, we take differences in the performance variables from 2019 (pre-pandemic) to 2021 (post-pandemic) to eliminate time-invariant firm-fixed effects. We then calculate the difference in these differences between the pair of each treatment and control observations and examine whether the mean of DIDs is different from zero.

As outcome variables, we employ the DIDs of the following variables. First, to examine the effect of COVID-19 business support programs on firms' liquidity positions, we use the ratio of cash outstanding to total assets ($dCashRatio$) and the ratio of total liabilities to total assets ($dLeverageRatio$). Second, to examine whether the programs reduced business failures and unemployment, we use the dummy variable for a firm's exit ($Exit$) and the number of a firm's employees ($dEmployment$). Note that we do not use the difference of $Exit$ because all our sample firms operated businesses in 2019 and thus $Exit$ was zero before the pandemic. Third, to evaluate the short-run effect of the programs on recipient firms' business performance, we use the credit score ($dScore$) and net profit-to-sales ratio ($dProfitRatio$). In addition, to examine whether the government programs increased zombie firms and/or low-return borrowers, we employ the dummy variables using the CHK, FN, BOJ_ROA, and BOJ_Leverage criteria ($dZombie_chk$, $dZombie_fn$, $dLowReturn_ROA$, and $dLowReturn_leverage$).

4. Results

In this section, we present results obtained from the empirical analyses whose procedure is outlined in the previous section. First, we show estimation results on the determinants of the receipt of business support programs. We also employ firms' zombie/low-return status measured prior to the pandemic as an alternative variable for their pre-pandemic attribute. Given the results of these estimates, second, we further present the results from our PSM-DID estimation.

4.1. Determinants of receiving business support programs

4.1.1 Baseline results

Table 4 shows estimation results of the equation (1). Each label corresponds to one of the four business support

programs, i.e., interest-free unsecured government loans, interest-free unsecured private loans, grants for business continuation, and subsidies for employment adjustment. For each support program we start from explaining the results for the baseline specification in which we do not include the firm-bank relationship variable. These estimation results are shown in columns (1), (3), (5), and (7). They are followed by the results shown in columns (2), (4), (6), and (8) for the specification including the firm-bank relationship variable. For the baseline there are two major findings.

First, the marginal effect estimates on the sales growth amid the pandemic ($MinSalesGrowth2020$) are negative and significant for the government loans and employment adjustment subsidies, while they are insignificant for the other two programs. The government employed the extent of monthly sales drop amid the pandemic for the eligibility condition for some programs and we limit the sample for estimations to those that satisfy the condition (see Section 3.3.1). As a result, the variable for the sales growth during the pandemic may have lost its explanatory power, especially for the grant for continuing businesses that had a stricter eligibility condition. Note, however, that there is still a difference in the size of the estimates between the government loan and private loan programs despite that their eligibility conditions are almost the same. The difference may be attributed to one or both of the following two reasons. First, firms that were most severely hit by the pandemic may have consulted with desks at the government banks first because the government banks had started the program one and a half months earlier than the private banks. We may say that the government loan program functioned as the safety net during the pandemic more than the private sector interest-free loan program did. Second, the private banks might have encouraged eligible but relatively well-performing firms to apply for these private loans. Because the government reimbursed the amount of interest payments for these loans and provided credit guarantees, the interest-free loans are beneficial not only for borrower firms but also for the private banks that originate them. It should also be noted that consistent with the marginal effect estimates on $MinSalesGrowth2020$, the marginal effect estimates for the prefecture-level stay-at-home rate ($StayHome$) are also significantly positive for governmental loans and the subsidy for employment adjustment.

Second, for all the four programs, the marginal effect estimates for the credit score measured prior to the pandemic ($Score2019$) are negative and statistically significant. They are consistent with the results reported in Hoshi, Kawaguchi, and Ueda (2022) in that the programs tended to be used by low-performing

firms as of prior to the pandemic. However, the size of the effect differs to some extent across programs. Here the absolute value of the marginal effect is the largest for the government loans, while in Hoshi, Kawaguchi and Ueda (2022), it was the largest for the private loans.[21]

4.1.2 Firm-bank relationships

The columns (2), (4), (6), and (8) in Table 4 show estimation results when we include the variable for the strength of the firm-bank relationships ($ExtentRelationship$) as an additional potential determinant. In addition to confirming the aforementioned results obtained in the baseline, we find that marginal effect estimates for the relationship variable are positive and significant except for the grant for continuing businesses.

These indicate that firms are more likely to receive funds from the support programs when they established more intimate relationships with their lender banks. Both of the loan programs provided by GFIs and private financial institutions are likely to be used by firms with such close relationships with banks, which is consistent with the finding reported in Balyuk, Prabhala and Puri (2021) and Li and Strahan (2021). Regarding the size of the estimates, we find that the marginal effect being more than double for the private bank loans than for the government loans. As the variable measures the extent of a firm's relationship with a bank that extended the largest outstanding amount of loans before the pandemic (or a bank that has the closest relationship in the case a firm did not have any loans outstanding), this relationship is more likely to be with a private bank rather than with a GFI. Therefore, the results suggest that private banks that have established close relationships with firms put more emphasis on the use of private interest-free loans rather than to encourage firms to use government loans.

4.1.3 Pre-pandemic zombie status

Table 5 lists the estimation results of the equation (2), with each four columns for one of the four business support programs. For each support program, we employ four different variables for a firm's zombie/low return status prior to the pandemic as a replacement of the variables that represent firms' pre-pandemic status. We

[21] The difference between Hoshi, Kawaguchi and Ueda's (2022) result and ours may stem from the estimation method used; Hoshi, Kawaguchi and Ueda (2022) used the linear probability model while we use the logit model and report the marginal effect in Table 4. In Uesugi et al. (2022), we used the linear probability model in which the dependent variable is the application of programs and found that the coefficient is the largest for government loans.

have the following two major findings.

First, we find that the marginal effect estimates for the zombie/low return dummies are mostly positive and significant, although the result is weaker in the case of $Zombie_chk$. This result contrasts with Hoshi, Kawaguchi, and Ueda (2022) that employed CHK's zombie status dummy variable in some of their estimations on the determinants of firms' business support programs to find no significant results. Second, similar to the results shown in Table 4, controlling for those zombie status, we still find the negative marginal effect estimates on $MinSalesGrowth2020$ and positive estimates on $StayHome$ in most cases.[22]

To summarize the results obtained in Tables 4 and 5, we find that the various business support programs are used by firms exhibiting relatively lower performance prior to the pandemic. These are not only firms with low credit scores but also those that are identified as zombie or low return firms. Controlling for the firm performance prior to the pandemic as an important determinant of using the support programs, we further find that the negative shock originating from the pandemic explains the use of governmental loans and employment adjustment subsidies, but we do not find evidence that the negative shock from the pandemic is correlated with the use of loans by private banks and the grants for continuing businesses. This suggests that some of the support programs were used more frequently by firms that were severely hit by the pandemic than those that were less damaged even when we restrict the estimation sample to eligible firms that decreased their sales amount substantially. We also find that the stay-at-home rate is positively associated with the use of the programs. In this sense, we may say that some of the support programs in Japan "hit the target," that is, firms that were severely damaged by the pandemic tend to receive funds from the programs. This finding contrasts with Granja et al. (2020), which find that funds by the PPP flowed to regions that were less adversely affected by the pandemic.

But at the same time, we find that firms that had been underperforming or were classified as zombies or low return firms before the pandemic also ended up being supported. This finding is consistent with that in Joaquim and Netto (2021) for the U.S., Boddin, D'Acunto and Weber (2020) for Germany, and Morikawa

[22] One remark is that we find statistically significant negative estimates for the sales growth for firms that received funds from private bank loans, which is not confirmed in the columns (3) and (4) of Table 4. This could be due to the omission of other firm attributes such as $Score2019$ that proxy for creditworthiness prior to the pandemic and have a negative association with the receipt of support. If this credit score is positively correlated with the sales growth amid the pandemic, the estimates associated with the sales growth variable in Table 5 could be underestimated (i.e., tend to be negative) due to the omitted variable bias.

(2021), Hoshi, Kawaguchi, and Ueda (2022), and Uesugi et al. (2022) for Japan. Finally, close firm-bank relationships played a substantial role in mediating a firm's access to the loan programs by GFIs and private banks and the employment adjustment subsidy. This finding is also consistent with studies which find that banks played important role in mediating government support programs (Balyuk et al. 2021, Li and Strahan 2021).

4.2. Treatment effects of receiving business support programs

4.2.1 Main results

Table 6 summarizes the treatment effect estimation results. In this table, each row and column account for the type of specific outcome variable and the type of specific business support program, respectively. There are four notable findings.

First, the rows of $dCashRatio$ show positive and significant effects for all the four programs, indicating that the use of each support program results in significantly higher liquidity holdings by firms. As these coefficients are the estimates of causal effect of the receipt of those programs, we find that the programs effectively increased firms' liquidity holdings.

Second, somewhat surprisingly, the increase in firms' liquidity holdings is not accompanied by an increase in $dLeverageRatio$ for the government and private bank loan programs. That is, we find no significant average treatment effects for all programs, although the point estimates are positive except for private bank loans. We also see that the standard errors for the coefficients on $dLeverageRatio$ are larger than those for $dCashRatio$, implying that the extent of a change in $dLeverageRatio$ largely varies among firms while that in $dCashRatio$ is more homogeneous. This could be the case when firms found it necessary to keep larger liquidity in their hands and thus used the loan programs but their cash flows were largely heterogeneous among firms. Some loan program users with abundant cash flows were able to increase their liquidity holdings and repay their existing loans simultaneously, while some other users that were not endowed with sufficient cash flows piled up their liquidity by increasing the loan amount outstanding. Uesugi et al. (2022) show that the standard deviation of monthly sales peaked in May 2020 and remained high for the rest of the period until September of the same year, indicating that the business conditions were highly

heterogeneous among firms during the pandemic. The seemingly puzzling inconsistency between the treatment effects on $dCashRatio$ and $dLeverageRatio$ could be explained by a common need for holding liquidity and a heterogeneous need for relying on external debt.

Third, the rows of $Exit$ show that the treatment effect is negative and significant for the private loan program. Point estimates for the other programs are negative, though insignificant. The negative treatment effect is presumably due to the better liquidity position, specifically in the case of loan provision by private banks. Another result one should look at is the rows for firms' employment behavior. Considering that one of the policy objectives is to curb an increase in unemployment and to maintain employment, the treatment effects for $dEmployment$ are expected to be positive, especially when firms receive the subsidies for employment adjustment. Contrary to our expectations, results indicate that none of the estimates are statistically significant for all the support programs, including the employment adjustment subsidies. One possible reason for this to happen is the firms' strong precautionary demand for cash, which may have led to the shortage of liquidity used for wages. The insignificant treatment effects are consistent with the small employment effect found in Granja et al. (2020) and Chetty et al. (2020) for the PPP in the U.S.

Last but not the least, for the rows for firm performance variables such as credit scores and profitability, the treatment effects are often negative and significant. Also, for the rows for zombie or low return status variables, the treatment effects are positive and significant for the majority of cases. Both of these results indicate that firms which use the support programs deteriorated their performance at least for one or two years after the start of the pandemic.

4.2.2 Results from subsample analyses

We also implement additional analyses to further examine the treatment effect of using these business support programs. For this purpose, we divide the sample into two by the three different characteristics before the pandemic: the amount of a firm's cash holdings, the extent of firm-bank relationships, and a firm's zombie/low return status.

First, we divide the sample into two according to the cash-to-asset ratio. The pre-pandemic level of cash holdings may affect the behavior of support program users. That is, program users with small ex-ante cash balances may be more willing to increase their cash amount than those with large cash holdings for the

precautionary motive. Also, the firms may be more likely to increase the loan amount outstanding to maintain their cash holdings rather than to decrease it. As shown in Appendix Table A2, we actually observe positive and significant treatment effects for $dCashRatio$ for firms with small cash balances. The effects are positive for all the support programs. We also find a positive treatment effect for $dLeverageRatio$ when firms with low cash balances use government loans. In contrast, for firms endowed with abundant cash balances, the treatment effect for $dCashRatio$ is positive and marginally significant for the government loans but the effects are insignificant for the rest of the programs.

Second, we divide the sample by the extent of firm-bank relationships. We categorize firms as those with close bank relationships when the value of $ExtentRelationship$ is larger than one and firms as those with weak bank relationships when it is no larger than one. Close firm-bank relationships may have some impact on banks' loan supply and firms' borrowing amount. Small firms tend to suffer from credit rationing in times of a crisis and it is conceivable that banks may withdraw loans when firms received funds from the business support programs. However, previous studies on relationship lending suggest that the banks that have a close relationship with the client firm tend to provide liquidity insurance when the firm is in financial distress (Bolton et al. 2016; Hoshi, Kashyap and Scharfstein, 1990). Thus, if firms have close relationships with banks, the banks would commit themselves to the firms' recovery and maintain their loan exposure to these firms even when the firms receive funds from the support programs. In contrast, if firm-bank relationships are weak, banks may become opportunistic and decrease their loan exposure to firms when the firms receive money from the programs. These intimate relationships may have some impact of firms' cash holdings, too. If firms have limited extent of relationships with banks and thus feel unsecured for their financing in times of crises, they may increase the amount of cash for precautionary motives during the period of the pandemic.

Results in Appendix Table 3 suggest that both of these predictions applied in reality. Firms that have established extensive relationships with banks see their loan balances to increase when they use the government loan program, while it is not the case for firms that have limited banking relationships. In addition, firms that have a limited extent of firm-bank relationships increase the amount of cash holdings during the pandemic by using any one of the programs, while those with close relationships do not significantly increase their cash holdings.

Third, we divide the sample by the pre-pandemic zombie/low return status. In this exercise we limit the sample either to zombie firms or to non-zombies at the time before the pandemic. We first focus on the sample of zombie firms and examine the treatment effects on remaining zombies. Then we focus on the sample of non-zombies to examine the treatment effects on becoming zombie firms. Thus, we are able to identify which direction (from non-zombies to zombie firms or from zombies to non-zombies) is more relevant as the treatment effect. Results (not shown in the paper) indicate that there exist positive treatment effects through both channels. That is, we find that both the probability for zombie firms to remain zombies and the probability for non-zombie firms to become zombies are higher for firms that receive funds from the support programs than for non-recipient firms. If anything, we find that the tendency for non-zombies becoming zombies is somewhat stronger than that for zombies remaining zombies, especially when we employ the FN criteria.[23] Note, however, that the results vary substantially across the programs and across the different zombie/low return firm criteria.

The results we obtained using the subsample by the pre-pandemic zombie/low return status suggests that we need to be careful when we interpret the results for zombie/low return firms. Although the results we reported above cover only for the first one or two years since the start of the pandemic, they suggest that zombie/non-zombie status changes frequently. To check this point further in a simple way, we construct a transition matrix of zombie/low return status using data during the pre-pandemic period (from 2014 to 2019). In Table 7, we show these matrices for all the four different criteria of zombie/low return firms.

First, when we focus on the zombie/low return firms in 2019, the probability of zombie firms in 2014 remaining zombies in 2019 is higher than the probability of non-zombies in 2014 becoming zombies in 2019. For example, in the case of CHK criterion, the former is 69% while the latter is 22%. This inequality holds for all the criterion of zombie/low return firms used in Table 7. In this sense, we may say that the zombie/low return status is persistent, so providing support to zombie firms is an inefficient policy and more targeted support to non-zombie firms is appropriate. Second, however, when we look at the extent to which zombie/low return firms in 2014 became non-zombie/low return firms in 2019, things may look different. As

[23] Specifically, we find that the average treatment effects for non-zombies becoming zombies are significantly positive for all 4 programs, while the average treatment effects for zombies remaining zombie are significantly positive for only the employment adjustment subsidy.

an example, when we look at the FN criterion, the probability that they became non-zombies is 71%, suggesting the possibility that most zombie firms exit from zombie status sooner or later. Note, however, that this probability varies substantially across the criteria used. For example, the probability is merely 20% when we employ BOJ_leverage criterion. In order to make a more definitive inferences on whether more targeted business support programs are desirable, we need to determine the appropriate definition of zombie firms, which we leave for future study.

5. Conclusion

Using a dataset that matches a survey and financial data from Japanese SMEs, this paper examined the determinants and the causal effects of the business support programs provided by the Japanese government during the COVID-19 pandemic. With respect to the determinants, our results indicate that while funds flowed to firms that were adversely affected by the pandemic, they also benefited firms that had been under-performing before the pandemic. Regarding the causal effects, our results indicate that while subsidized loans from private banks lowered exit rates, no program including subsidies for employment adjustment significantly increased employment. Moreover, the programs had a serious side effect of deteriorating surviving firms' performance at least in the short run, although the long-run effects are yet to be seen. Overall, our results suggest that we need to cautiously see the aftermath of firms that used business support programs in times of a crisis.

Several issues are left for future work. Obviously, we need to continuously investigate the long-run effects of the support programs. Specifically, it will be important to see whether the firms that used the programs and became a zombie or a low return firm will turn to be healthy or remain to be in the same status in the future. Moreover, while we have shown that the number of zombies could have been smaller if the programs were not provided, we need to further examine the welfare implications and aggregate effects of the programs. For these aims, it will be useful to examine the effects of the programs on the allocation of resources such as labor and capital between surviving firms and exiting firms. As Bloom et al. (2022) describe, the usual Schumpeterian mechanism might not be working under the large shock such as the current pandemic. We need to consider such a specific aspect of the pandemic for our further examination.

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Table 1: Definitions of variables

This table presents the definitions of the variables used in our estimations (Tables 4–6). Regarding the data sources, “RIETI survey” stands for the “Survey on the Status of Firms under the COVID-19 Pandemic” conducted by the Research Institute of Economy, Trade and Industry (RIETI) in November 2020 and “TSR” stands for the database of the Tokyo Shoko Research (TSR).

Variable names	Definitions	Source
Variables on the use of business support programs		
Receive_GovLoan	1 if a firm receives interest-free unsecured loans from government-affiliated financial institutions (GFIs), and 0 otherwise.	RIETI survey
Receive_PrivateLoan	1 if a firm receives interest-free unsecured loans from private financial institutions, and 0 otherwise	RIETI survey
Receive_GrantContinue	1 if a firm obtains grants for continuing businesses, and 0 otherwise.	RIETI survey
Receive_SubsidyEmp	1 if a firm obtains subsidies for employment adjustment, and 0 otherwise.	RIETI survey
Explanatory variables		
MinSalesGrowth2020	Smallest monthly sales ratio growth relative to the previous year for February through September 2020. It takes the value of 100 if the monthly sales amount is unchanged from the same month last year and 50 if it is half of the level a year ago.	RIETI survey
Score2019	Credit score for a firm (0-100) recorded by a credit research company (Tokyo Shoko Research) in 2019	TSR
ExtentRelationship	Number of choices a firm responds "yes" regarding qualitative characteristics of a firm's relationship with the bank whose loan amount outstanding is the largest or whose ties with the firm is the closest. Five choices include: (1) the bank recognizes a firm's unnoticed strength; (2) it provides consultation services to a firm in addition to loans; (3) it provides useful information and assistance on managerial issues other than financing; (4) it points out a firm's managerial problems and gives advice on how to deal with them; and (5) it maintains close relationships with a firm in general.	RIETI survey
Zombie_chk	1 if categorized as a zombie in 2019 according to Caballero, Hoshi, and Kashyap's (2008) criteria, and 0 otherwise. See Table A1 in the Appendix for more specific definitions.	TSR
Zombie_fn	1 if categorized as a zombie in 2019 according to Fukuda and Nakamura's (2011) criteria, and 0 otherwise. See Table A1 in the Appendix for more specific definitions.	TSR
LowReturn_roa	1 if categorized as an underperforming firm in 2019 according to the ROA criteria set by the Bank of Japan (2018), and 0 otherwise. See Table A1 in the Appendix for more specific definitions.	TSR
LowReturn_leverage	1 if categorized as an underperforming firm in 2019 according to the leverage criteria set by the Bank of Japan (2018), and 0 otherwise. See Table A1 in the Appendix for more specific definitions.	TSR
lnSales	Log of a firm's sales amount in 2019	TSR
lnEmployment	Log of a firm's number of employees in 2019	TSR
CurrentRatio	Outstanding amount of current assets / outstanding amount of liquid liabilities in 2019. Current assets include cash and deposits, accounts and bills receivables, and short-term securities, while liquid liabilities include accounts and bills payables, short-term loans and bonds, payments in arrears, and allowances for bonuses.	TSR
StayHome	Extent of an increase in the ratio of people staying at home rather than going out. 1- (number of people being out of home in May 2020 * their out of home hours in the month)/ (number of people being out of home in normal times * their out of home hours in normal times). It is measured at the prefecture level.	Takayuki Mizuno's laboratory (http://research.nii.ac.jp/~mizuno/)

Table 1: Definitions of variables (continued)

Ex-post outcome variables for the PSM-DID estimations		
dCashRatio	A firm's outstanding amount of cash / total asset in 2021 minus that in 2019	TSR
dLeverageRatio	A firm's outstanding amount of liabilities / total asset in 2021 minus that in 2019	TSR
Exit	1 if a firm falls into one of the categories in 2021: bankruptcy, suspension or shut down of a firm's business, and 0 otherwise.	TSR
dEmployment	A firm's number of employees in 2021 minus that in 2019	TSR
dScore	A firm's credit score (0-100) recorded by a credit research company (Tokyo Shoko Research) in 2021 minus that in 2019	TSR
dProfitRatio	A firm's net profit / sales in 2021 minus that in 2019	TSR
dZombie_chk	Difference between the dummy variables indicating whether a firm is categorized as a zombie according to Caballero, Hoshi, and Kashyap's (2008) criteria in 2021 and that in 2019	TSR
dZombie_fn	Difference between the dummy variables indicating whether a firm is categorized as a zombie according to Fukuda and Nakamura's (2011) criteria in 2021 and that in 2019	TSR
dLowReturn_roa	Difference between the dummy variables indicating whether a firm is categorized as an underperforming firm according to the ROA criteria set by the Bank of Japan (2018) criteria in 2021 and that in 2019	TSR
dLowReturn_leverage	Difference between the dummy variables indicating whether a firm is categorized as an underperforming firm according to the leverage criteria set by the Bank of Japan (2018) criteria in 2021 and that in 2019	TSR

Table 2: Firms' use of funds provided by the COVID-19 business support programs

This table presents the numbers and the percentage shares of firms that received and did not receive the funds by the COVID-19 business support programs and the percentage shares of firms that applied for but failed to receive funds ("rejection ratio").

	Received funds	Did not receive funds			Number of respondent firms	Rejection ratio
		Considered but did not apply for the program	Applied for but failed to receive funds by the program	Neither considered nor applied for the program		
	a	b1	b2	b3	a+b1+b2 +b3	(b2)/(a+b2)
1. Special loan program by the	1,076	31	25	2,625	3,757	
GFIs	28.6	0.8	0.7	69.9	100.0	2.3
2. Other programs by the GFIs	383	15	19	3,057	3,474	
	11.0	0.4	0.5	88.0	100.0	4.7
3. Special loan program by the	1,813	26	18	1,980	3,837	
private financial institutions	47.3	0.7	0.5	51.6	100.0	1.0
4. Other public guaranteed loan	486	13	9	2,904	3,412	
programs	14.2	0.4	0.3	85.1	100.0	1.8
5. Grants and subsidies for	1,638	30	7	2,153	3,828	
continuing businesses	42.8	0.8	0.2	56.2	100.0	0.4
6. Support money in	634	7	7	2,862	3,510	
compensation for business closure	18.1	0.2	0.2	81.5	100.0	1.1
7. Subsidies for employment	1,383	14	6	2,297	3,700	
adjustment	37.4	0.4	0.2	62.1	100.0	0.4
8. Grants for rent payment	603	41	46	2,848	3,538	
	17.0	1.2	1.3	80.5	100.0	7.1

Table 3: Summary statistics

This table presents the summary statistics of the variables used in our estimations. See Table 1 for the definitions of the variables. The sample in this table corresponds to firms for which we can estimate the logit regressions using Equation (1) for at least one of the eight programs asked in the RIETI survey (see Table 2).

Variable names	N	mean	sd	min	p25	p50	p75	max
Variables on the use of business support programs								
Receive_GovLoan	1,913	0.270	0.444	0	0	0	1	1
Receive_PrivateLoan	1,956	0.464	0.499	0	0	0	1	1
Receive_GrantContinue	1,924	0.365	0.482	0	0	0	1	1
Receive_SubsidyEmp	1,891	0.353	0.478	0	0	0	1	1
Explanatory variables								
MinSalesGrowth2020	2,133	58.059	27.398	0	40	60	80	120.7
Score2019	2,133	53.648	6.898	33	49	53	58	79
ExtentRelationship	2,133	2.096	1.580	0	1	2	3	5
Zombie_chk	1,969	0.375	0.484	0	0	0	1	1
Zombie_fn	1,969	0.113	0.317	0	0	0	0	1
LowReturn_roa	1,969	0.233	0.423	0	0	0	0	1
LowReturn_leverage	1,969	0.389	0.488	0	0	0	1	1
lnSales	2,133	11.497	1.695	4.159	10.378	11.437	12.573	20.252
lnEmployment	2,133	3.444	1.315	0	2.565	3.401	4.331	8.570
CurrentRatio	2,133	2.472	19.116	0.002	0.784	1.258	2.149	865
StayHome	2,133	0.338	0.093	0.167	0.274	0.318	0.374	0.505
Ex-post outcome variables for the PSM-DID estimations								
dCashRatio	1,423	0.043	0.106	-0.606	-0.008	0.029	0.092	0.516
dLeverageRatio	1,423	0.011	0.639	-9.922	-0.038	0.000	0.051	20.767
Exit	2,133	0.003	0.057	0	0	0	0	1
dEmployment	1,423	7.030	276.992	-2189	-2	0	2	10138
dScore	1,646	-0.365	2.348	-16	-2	0	1	14
dProfitRatio	1,423	-0.005	0.217	-4.802	-0.019	0.001	0.018	2.958
dZombie_chk	1,299	0.032	0.421	-1	0	0	0	1
dZombie_fn	1,299	0.048	0.418	-1	0	0	0	1
dLowReturn_roa	1,299	-0.005	0.459	-1	0	0	0	1
dLowReturn_leverage	1,299	-0.072	0.385	-1	0	0	0	1

Table 4: Determinants of the receipt of the COVID-19 business support programs

This table presents the marginal effects of the baseline estimations on the determinants of the receipt of the COVID-19 business support programs obtained in the logit regression in Equation (1) in the main text. Figures in parentheses are standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation method: logit model estimation								
Dependent variable	Receive_GovLoan		Receive_PrivateLoan		Receive_GrantContinue		Receive_SubsidyEmp	
Explanatory variables								
MinSalesGrowth2020	-0.00268***	-0.00265***	-0.000874	-0.000842	-0.00155	-0.00150	-0.00338***	-0.00333***
	(0.000521)	(0.000519)	(0.000554)	(0.000545)	(0.00111)	(0.00112)	(0.000449)	(0.000447)
Score2019	-0.0169***	-0.0157***	-0.0114***	-0.00865***	-0.00836**	-0.00812*	-0.00598***	-0.00465**
	(0.00236)	(0.00239)	(0.00249)	(0.00249)	(0.00426)	(0.00431)	(0.00220)	(0.00221)
ExtentRelationship		0.0235***		0.0584***		0.00492		0.0278***
		(0.00782)		(0.00798)		(0.0138)		(0.00722)
lnSales	0.0193	0.0120	-0.00265	-0.0184	-0.0376*	-0.0390*	-0.0177	-0.0258*
	(0.0147)	(0.0148)	(0.0151)	(0.0151)	(0.0212)	(0.0216)	(0.0137)	(0.0138)
lnEmp	0.0394**	0.0351**	0.0186	0.00708	-0.0217	-0.0235	0.105***	0.102***
	(0.0169)	(0.0169)	(0.0174)	(0.0173)	(0.0334)	(0.0338)	(0.0151)	(0.0150)
CurrentRatio	-0.0104*	-0.0100*	-0.0111**	-0.0103**	-0.00118	-0.00126	0.00139	0.00185
	(0.00572)	(0.00559)	(0.00493)	(0.00464)	(0.00520)	(0.00524)	(0.00451)	(0.00446)
StayHome	0.402***	0.451***	-0.166	-0.0751	0.282	0.291	0.389***	0.449***
	(0.131)	(0.132)	(0.142)	(0.141)	(0.223)	(0.224)	(0.124)	(0.125)
Number of observations	1,414	1,414	1,537	1,537	413	413	1,721	1,721
LRchi^2	111.31	120.20	49.50	98.63	22.92	23.05	116.50	130.90
Prob > chi^2	0.0000	0.0000	0.0000	0.0000	0.0008	0.0017	0.0000	0.0000
Pseudo R^2	0.0627	0.0677	0.0232	0.0463	0.0565	0.0568	0.0514	0.0577
Log likelihood	-831.8779	-827.4361	-1040.3065	-1015.7402	-191.5485	-191.4848	-1075.4040	-1068.2004

Table 5: Determinants of the receipt of the COVID-19 business support programs using the Zombie or Low-return firm dummies for explanatory variables

This table presents the marginal effects of the baseline estimations on the determinants of the receipt of the COVID-19 business support programs obtained in the logit regression in Equation (2) in the main text. Figures in parentheses are standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation method: logit model estimation								
Dependent variable:	Receive_GovLoan				Receive_PrivateLoan			
Variable for Zombie/Low return dummy:	Zombie_chk	Zombie_fn	LowReturn_roa	LowReturn_leverage	Zombie_chk	Zombie_fn	LowReturn_roa	LowReturn_leverage
Explanatory variables								
MinSalesGrowth2020	-0.00217***	-0.00210***	-0.00224***	-0.00222***	-0.00156***	-0.00153***	-0.00164***	-0.00157***
	(0.000496)	(0.000495)	(0.000494)	(0.000486)	(0.000510)	(0.000508)	(0.000508)	(0.000505)
Zombie/Low return dummy	0.00665	0.0839**	0.105***	0.180***	-0.00320	0.109***	0.0805***	0.125***
	(0.0244)	(0.0342)	(0.0263)	(0.0213)	(0.0254)	(0.0378)	(0.0283)	(0.0240)
StayHome	0.521***	0.528***	0.529***	0.457***	-0.111	-0.105	-0.103	-0.146
	(0.126)	(0.126)	(0.126)	(0.124)	(0.137)	(0.136)	(0.136)	(0.136)
Number of observations	1,548	1,548	1,548	1,548	1,698	1,698	1,698	1,698
LRchi^2	31.84	37.55	46.77	94.34	10.47	18.69	18.47	36.16
Prob > chi^2	0.0000	0.0000	0.0000	0.0000	0.0510	0.0003	0.0004	0.0000
Pseudo R^2	0.0166	0.0195	0.0243	0.0491	0.0045	0.0079	0.0079	0.0154
Log likelihood	-945.7188	-942.8619	-938.2516	-914.4690	-1170.6703	-1166.5601	-1166.6665	-1157.8245

Table 5 (continued)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Estimation method: logit model estimation								
Dependent variable:	Receive_GrantContinue				Receive_SubsidyEmp			
Variable for Zombie/Low return dummy:	Zombie _chk	Zombie _fn	LowReturn_ roa	LowReturn_ leverage	Zombie _chk	Zombie _fn	LowReturn_ roa	LowReturn_ leverage
Explanatory variables								
MinSalesGrowth2020	-0.00181	-0.00176	-0.00201*	-0.00187	-0.00236***	-0.00219***	-0.00236***	-0.00222***
	(0.00120)	(0.00119)	(0.00118)	(0.00120)	(0.000416)	(0.000416)	(0.000413)	(0.000414)
Zombie/Low return dummy	-0.00993	0.0745	0.176***	0.0403	0.0608***	0.111***	0.131***	0.101***
	(0.0432)	(0.0583)	(0.0548)	(0.0418)	(0.0223)	(0.0329)	(0.0245)	(0.0215)
StayHome	0.344	0.344	0.366	0.342	0.554***	0.571***	0.580***	0.532***
	(0.245)	(0.243)	(0.241)	(0.244)	(0.117)	(0.117)	(0.116)	(0.117)
Number of observations	420	420	420	420	1,875	1,875	1,875	1,875
LRchi^2	4.05	5.73	15.75	4.93	53.13	56.69	72.52	66.69
Prob > chi^2	0.2558	0.1257	0.0013	0.1767	0.0000	0.0000	0.0000	0.0000
Pseudo R^2	0.0091	0.0128	0.0353	0.0110	0.0218	0.0233	0.0298	0.0274
Log likelihood	-221.2823	-220.4451	-215.4350	-220.8415	-1189.7041	-1187.9209	-1180.0074	-1182.9243

Table 6: Ex-post performance of firms that receive funds from the COVID-19 business support programs

This table presents the average treatment effects of receiving the COVID-19 business support programs obtained in the PSM-DID estimations in Section 3.3.2. in the main text. Figures in parentheses in the second rows are standard errors and those in the third rows are the number of observations. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

		Receive_ GovLoan	Receive_ PrivateLoan	Receive_ GrantContinue	Receive_ SubsidyEmp
dCashRatio	Treatment effect	0.0248***	0.0229***	0.0827***	0.0153**
	s.e.	(0.00835)	(0.00671)	(0.0217)	(0.00629)
	NOB	919	1,007	224	1,145
dLeverageRatio	Treatment effect	0.0442	-0.0135	0.130	0.0404
	s.e.	(0.0371)	(0.0408)	(0.124)	(0.0318)
	NOB	919	1,007	224	1,145
Exit	Treatment effect	-0.00464	-0.0108**	-0.0140	-0.00128
	s.e.	(0.00412)	(0.00495)	(0.0157)	(0.00231)
	NOB	1,414	1,537	413	1,721
dEmployment	Treatment effect	0.941	-0.318	-0.317	-13.38
	s.e.	(0.793)	(0.785)	(0.513)	(15.01)
	NOB	919	1,007	224	1,145
dScore	Treatment effect	-0.780***	-0.328**	-0.661***	-1.024***
	s.e.	(0.156)	(0.141)	(0.228)	(0.127)
	NOB	1,082	1,179	303	1,332
dProfitRatio	Treatment effect	-0.0507***	0.00149	-0.00386	-0.0556***
	s.e.	(0.0160)	(0.0210)	(0.0366)	(0.0167)
	NOB	919	1,007	224	1,145
dZombie_chk	Treatment effect	0.0928***	0.0650**	0.0414	0.0107
	s.e.	(0.0354)	(0.0305)	(0.0723)	(0.0291)
	NOB	839	921	186	1,044
dZombie_fn	Treatment effect	0.0833**	0.0853***	0.158*	0.0646**
	s.e.	(0.0400)	(0.0279)	(0.0939)	(0.0298)
	NOB	839	921	186	1,044
dLowReturn_roa	Treatment effect	0.0970***	0.0454	0.118	0.0932***
	s.e.	(0.0361)	(0.0318)	(0.0937)	(0.0310)
	NOB	839	921	186	1,044
dLowReturn_leverage	Treatment effect	0.0540*	-0.00890	0.165**	0.00565
	s.e.	(0.0297)	(0.0244)	(0.0646)	(0.0243)
	NOB	839	921	186	1,044

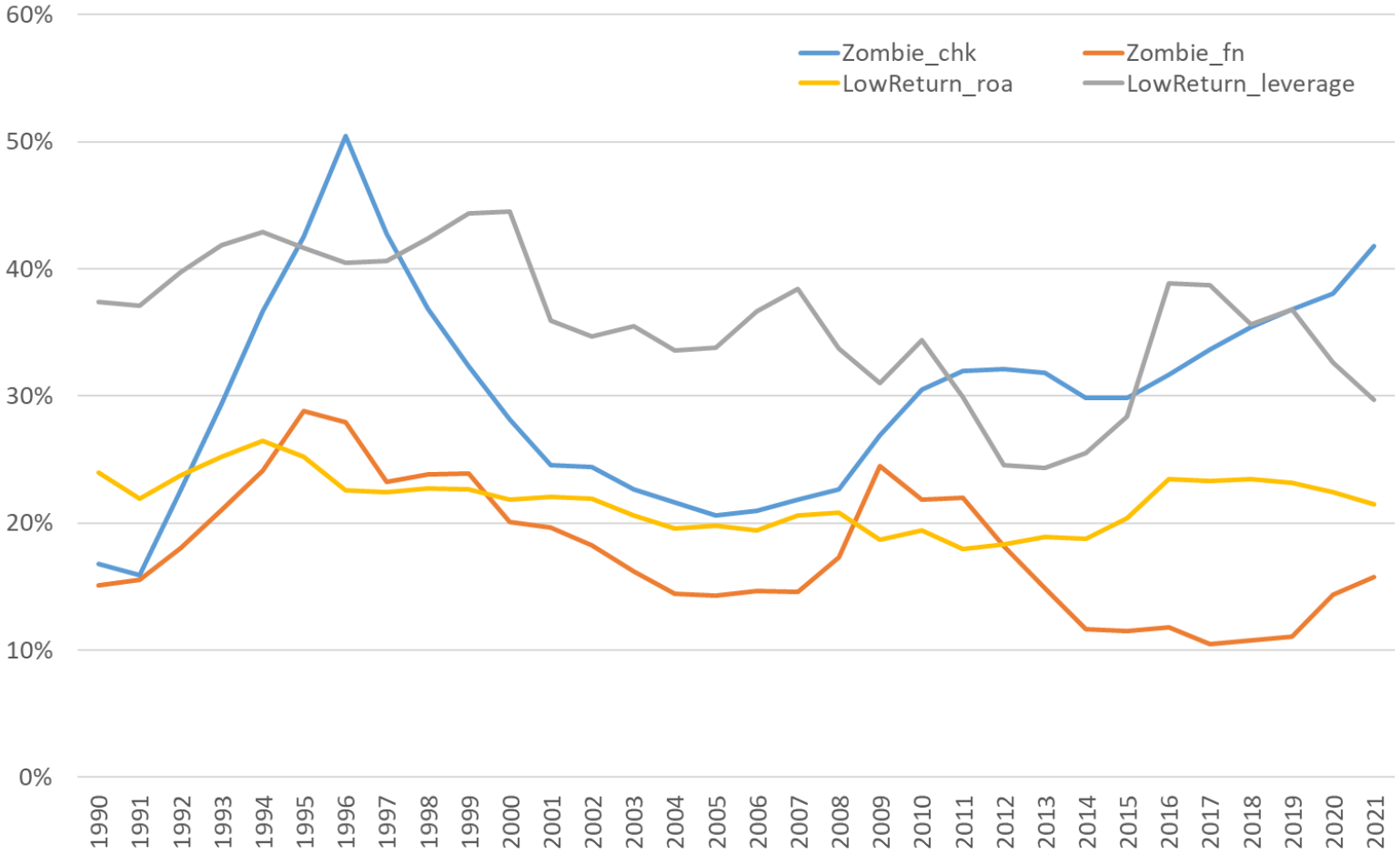
Table 7: Transitions of the Zombie and Low-return firms between 2014 and 2019

This table presents the transitions on the number of firms that were classified as the Zombie or Low-return firms between 2014 and 2019 using the four criteria explained in Section 3.2.3. Figures in parentheses represent the percentage shares of firms that were either non-zombie/Non-low-return firms, Zombie/Low-return firms, or had exited in 2019 among firms that were non-zombie/Non-low-return or Zombie/Low-return firms in 2014.

		2019				Share of Zombie/Low-return firms	
Criteria	**2014**	Non-zombie/Non-	Zombie/Low-return	Exit	Total	2014	2019
Zombie_chk	Non-zombie	2,936	855	100	3,891	29.7%	36.7%
		(0.755)	(0.220)	(0.026)	(1.000)		
	Zombie	492	1,134	19	1,645		
		(0.299)	(0.689)	(0.012)	(1.000)		
Zombie_fn	Non-zombie	4,420	421	93	4,934	10.9%	10.5%
		(0.896)	(0.085)	(0.019)	(1.000)		
	Zombie	430	146	26	602		
		(0.714)	(0.243)	(0.043)	(1.000)		
LowReturn_roa	Non-low-Return	3,684	756	94	4,534	18.1%	22.9%
		(0.813)	(0.167)	(0.021)	(1.000)		
	Low-return	492	485	25	1,002		
		(0.491)	(0.484)	(0.025)	(1.000)		
LowReturn_leverage	Non-low-Return	3,188	890	89	4,167	24.7%	36.1%
		(0.765)	(0.214)	(0.021)	(1.000)		
	Low-return	271	1068	30	1,369		
		(0.198)	(0.780)	(0.022)	(1.000)		

Figure 1: Development of the share of the Zombie and Low-return firms

This figure presents the percentage share of firms that were classified as the Zombie or Low-return firms using the sample of firms who responded to either one of the 2008, 2009, 2014, and 2020 RIETI surveys.



Appendix Table A1: Definitions of the Zombie and Low-return firms

Criterion	Definitions
Caballero, Hoshi, and Kashyap criterion for zombie firms (Zombie_chk)	Firms whose borrowing rates are lower than the most preferential rates. The borrowing interest rate and the most preferential interest rate are calculated as follows: Borrowing interest rate = interests and discount charges / outstanding amount of loans extended by financial institutions. Most preferential interest rate = Short-term prime rate * Share of short-term borrowings in the previous year + Long-term prime rate (average of past five years) * Share of long-term borrowings in the previous year. Note that the CHK criterion uses the lowest convertible bond interest rate (coupon rate) issued in the past five years when measuring the most preferential interest rate. However, we do not use the convertible bond rate in the calculation of the most preferential interest rate because SMEs that comprise the majority of our sample rarely issue corporate bonds.
Fukuda and Nakamura criterion for zombie firms (Zombie_fn)	Firms that meet either one of the following conditions (1) or (2). (1) Profitability condition: Borrowing interest rate is lower than the most preferential interest rate, and ROA (pretax profit/total assets) is no larger than the most preferential interest rate. (2) Forbearance lending condition: ROA (pretax profit/total assets) is no larger than the most preferential interest rate, debt ratio (debt/total assets) is larger than 50%, and the year-on-year borrowing growth rate is positive.
BOJ_ROA criterion for low return firms (LowReturn_roa)	Firms that satisfy the following two conditions for two consecutive years: (1) Borrowing interest rate is smaller than the average borrowing interest rate for the top 10% firms in terms of ROA. (2) Their ROA (pretax profit/total assets) is smaller than the median ROA for all sample firms.
BOJ_Leverage criterion for low return firms (LowReturn_leverage)	Firms that satisfy the following two conditions for two consecutive years: (1) Borrowing interest rate is smaller than the average borrowing interest rate of firms in the bottom 50% in terms of debt ratio. (2) Debt ratio (debt/total assets) is larger than the median debt ratio for all sample firms.

Appendix Table A2: Ex-post performance of firms that receive funds from the COVID-19 business support programs (subsample analysis by the size of cash ratios)

This table presents the average treatment effects of receiving the COVID-19 business support programs obtained in the PSM-DID estimations in Section 3.3.2. in the main text, using the subsamples of firms whose cash-to-assets ratio is below or above the median. Figures in parentheses in the second rows are standard errors and those in the third rows are the number of observations. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Receive_GovLoan	Receive_PrivateLoan	Receive_GrantContinue	Receive_SubsidyEmp	Receive_GovLoan	Receive_PrivateLoan	Receive_GrantContinue	Receive_SubsidyEmp
	Firms with small cash ratios				Firms with large cash ratios			
dCashRatio	0.0337***	0.0264**	0.0896***	0.0262**	0.0172*	0.00930	0.0561	-0.000520
	(0.0113)	(0.0116)	(0.0217)	(0.0134)	(0.0102)	(0.00777)	(0.0448)	(0.00708)
	369	414	116	446	550	593	107	699
dLeverageRatio	0.134***	-0.0111	-0.00634	0.0867**	-0.0263	-0.0587	0.243	0.00337
	(0.0409)	(0.0673)	(0.111)	(0.0357)	(0.0572)	(0.117)	(0.196)	(0.0342)
	369	414	116	446	550	593	107	699
Exit	0	0	0	0	-0.00545	-0.00405	0	0.00200
	(0)	(0)	(0)	(0)	(0.00643)	(0.00495)	(0)	(0.00196)
	369	414	116	446	550	593	106	699
dEmployment	0.0324	-0.849	-1.095*	-2.332**	1.699	-0.434	1.400	-20.40
	(0.751)	(0.940)	(0.574)	(1.131)	(1.248)	(1.144)	(1.117)	(32.55)
	369	414	116	446	550	593	107	699
dScore	-0.573**	-0.236	-0.810**	-1.022***	-0.538***	-0.271	-0.528*	-1.021***
	(0.284)	(0.274)	(0.366)	(0.243)	(0.193)	(0.204)	(0.319)	(0.166)
	369	414	116	446	549	592	107	698
dProfitRatio	-0.0474	-0.0222	-0.0924	-0.0911**	-0.0498***	-0.0179	0.0736**	-0.0337**
	(0.0373)	(0.0204)	(0.0827)	(0.0450)	(0.0161)	(0.0219)	(0.0321)	(0.0138)
	369	414	116	446	550	593	107	699
dZombie_chk	-0.0827	-0.0344	-0.0226	-0.0147	0.134***	0.104***	0.312**	-0.00124
	(0.0719)	(0.0475)	(0.109)	(0.0494)	(0.0387)	(0.0336)	(0.122)	(0.0373)
	331	371	96	401	508	550	88	643
dZombie_fn	0.0114	0.0924**	0.223**	0.0732	0.0849*	0.100**	0.0288	0.0485
	(0.0490)	(0.0414)	(0.109)	(0.0487)	(0.0467)	(0.0407)	(0.113)	(0.0380)
	331	371	96	401	508	550	88	643
dLowReturn_roa	0.170**	0.0696	0.214**	0.0821*	0.101**	0.0840*	-0.0318	0.100**
	(0.0663)	(0.0451)	(0.101)	(0.0493)	(0.0416)	(0.0457)	(0.156)	(0.0402)
	331	371	96	401	508	550	88	643
dLowReturn_leverage	0.0324	-0.0205	0.295***	0.0225	0.0519	0.0342	-0.0409	0.00964
	(0.0441)	(0.0431)	(0.0896)	(0.0358)	(0.0342)	(0.0333)	(0.0494)	(0.0323)
	331	371	96	401	508	550	88	643

Appendix Table A3: Ex-post performance of firms that receive funds from the COVID-19 business support programs (subsample analysis by the extent of firm-bank relationships)

This table presents the average treatment effects of receiving the COVID-19 business support programs obtained in the PSM-DID estimations in Section 3.3.2. in the main text, using the subsamples of firms whose value of $ExtentRelationship$ (see Table 1 for the definition) is below or above the median. Figures in parentheses in the second rows are standard errors and those in the third rows are the number of observations. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Receive_GovLoan	Receive_PrivateLoan	Receive_GrantContinue	Receive_SubsidyEmp	Receive_GovLoan	Receive_PrivateLoan	Receive_GrantContinue	Receive_SubsidyEmp
	Firms with extensive relationships with banks				Firms with less extensive relationships with banks			
dCashRatio	0.0147	0.0134	0.0338	0.00578	0.0385*	0.0315**	0.136***	0.0246**
	(0.00906)	(0.00823)	(0.0338)	(0.00720)	(0.0198)	(0.0129)	(0.0224)	(0.0111)
	543	608	97	685	375	399	127	460
dLoanRatio	0.0366***	0.0160	0.0325	0.0380***	-0.0266	-0.0379	0.175	0.0878
	(0.0115)	(0.0114)	(0.0326)	(0.00888)	(0.171)	(0.0858)	(0.218)	(0.0738)
	543	608	97	685	375	399	127	460
Exit	-0.00619	-0.00694*	0.00795	0.00162	0.00175	-0.00921**	-0.0447	-0.00190
	(0.00391)	(0.00413)	(0.00783)	(0.00183)	(0.00608)	(0.00445)	(0.0569)	(0.00410)
	803	893	176	985	610	644	237	736
dEmployment	1.612	-0.315	0.157	3.827	-0.515	-0.323	-0.900	-20.82
	(1.100)	(1.039)	(0.623)	(4.752)	(0.996)	(1.061)	(0.689)	(42.56)
	544	608	97	685	375	399	127	460
dScore	-0.745***	-0.281	-0.243	-1.117***	-1.024***	-0.0260	-0.998***	-0.869***
	(0.200)	(0.201)	(0.357)	(0.152)	(0.343)	(0.245)	(0.231)	(0.253)
	624	687	129	773	458	492	174	559
dProfitRatio	-0.0189*	-0.0153	0.0131	-0.0355***	-0.112***	0.00300	-0.0196	-0.0929
	(0.0102)	(0.00951)	(0.0212)	(0.00836)	(0.0415)	(0.0316)	(0.0584)	(0.0585)
	544	608	97	685	375	399	127	460
dZombie_chk	0.0271	0.0805**	-0.102	0.0182	0.136**	0.0225	0.0712	0.0353
	(0.0418)	(0.0389)	(0.102)	(0.0352)	(0.0674)	(0.0498)	(0.0993)	(0.0510)
	506	565	84	634	333	356	102	410
dZombie_fn	0.0419	0.0710**	-0.0714	0.0652*	0.140*	0.120***	0.305***	0.0387
	(0.0455)	(0.0347)	(0.134)	(0.0346)	(0.0720)	(0.0439)	(0.0988)	(0.0540)
	506	565	84	634	333	356	102	410
dLowReturn_roa	0.133***	0.0418	0.0786	0.138***	0.0840	0.114**	0.182**	0.0772*
	(0.0444)	(0.0446)	(0.154)	(0.0397)	(0.0651)	(0.0520)	(0.0768)	(0.0465)
	506	565	84	634	333	356	102	410
dLowReturn_leverage	0.0734*	-0.00367	0.186**	0.00389	0.0406	0.0404	0.124	0.0605*
	(0.0403)	(0.0382)	(0.0856)	(0.0317)	(0.0408)	(0.0338)	(0.0975)	(0.0333)
	506	565	84	634	333	356	102	410