Public Guarantees, Relationship Lending and Bank Credit: Evidence from the COVID-19 Crisis

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Abstract

We analyze the effects of public credit guarantees on the allocation and performance of bank credit. We focus on the role of private bank incentives when lending decisions on partially public guaranteed loans (PGL) are delegated to banks. To guide the empirical strategy, we build a stylized model in which banks' private incentives, due to their pre-existing debt with a firm, shape the granting of PGL to firms after a crisis shock. For identification, we exploit the COVID-19 crisis and the Spanish credit register with unique information on COVID PGL. During the COVID crisis we find that: First, ex-ante riskier firms and riskier banks participate more on PGL, while the opposite happens on non-PGL (private credit). Second, firms are more likely to obtain a PGL from banks to which they have larger pre-COVID credit exposures, measured as the share of the firm's total credit outstanding with the bank before the shock. This effect is stronger for ex-ante riskier firms and for firms in more pandemic-affected sectors, and this riskier lending is especially stronger by ex-ante riskier banks. These latter effects are the opposite in (private) non-PGL. Moreover, PGL have larger volumes and lower rates than non-PGL, with stronger effects the larger the pre-COVID firm-bank credit exposures are, thereby suggesting a credit supply mechanism. Third, the guarantee scheme results in credit substitution at the firm-bank level. For firms that obtain a PGL from a bank, the total share and amount of credit from such bank increases, while the total share and amount of nonguaranteed (private) credit from such bank declines, in part reflecting both early prepayment and less ex-post delinquencies of outstanding private credit. These effects are stronger for ex-ante riskier firms and notably in conjunction with riskier banks. Our results show that the allocation of government guaranteed credit is shaped by banks' private incentives —notably pre-existing bank-firm credit exposures— resulting on risk shifting of credit to riskier firms by riskier banks to taxpayers.

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1. Introduction

The COVID-19 pandemic and ensuing lockdowns halted large parts of the economy, causing a liquidity squeeze and dash for cash by firms (Eichenbaum et al., 2020; Guerrieri et al., 2020; Ding et al., 2020; Li et al., 2020; and Acharya et al., 2020). This prompted large-scale government interventions to keep firms afloat, including pay protection programs for employees and loan guarantee schemes (Granja et al., 2020; Humphries et al., 2020; Chodorow-Reich et al., 2021; Baudino, 2020; and Falagiarda et al., 2020). Crucially, some COVID-19 related policies were implemented through third parties (i.e., delegated), notably public guarantee loans (PGL), as PGL granting decisions were delegated to privately-owned banks. While the merits of such government interventions in terms of supporting the overall economy have been well documented in the literature (e.g., Mankiw, 1986; and Philippon and Schnabl, 2013), there is a classic economic problem: the possible divergence between bank private incentives (agent) and social incentives (principal). Hence, bank incentives could affect the effectiveness of the policy action. In this paper, we analyze the effects of public credit guarantee schemes on the allocation and performance of bank credit, focusing on the role of private bank incentives when lending decisions on partially public guaranteed loans (PGL) are delegated to banks.

To guide the empirical analysis, we build a stylized model in which banks' private incentives shape the granting of public guaranteed loans. In the model, an exogenous negative shock to firm profitability (from COVID-19) can reduce firms' credit worthiness and reduce bank lending incentives. For a large enough shock (private) lending can be impaired. We show how, in such cases, a subsidized PGL system can increase bank lending incentives and how banks have more incentives to use subsidized PGL the larger the pre-existing credit exposure to the firm. This is because by doing so the bank increases the repayment probability of pre-existing loans. A key testable prediction generated by the model is, therefore, that pre-existing credit exposure is a key determinant of PGL granting decisions. Moreover, the model predicts that this effect depends on firm and bank characteristics, including firm risk and bank risk (poorly capitalized banks). For empirical identification, we exploit the COVID-19 crisis and the Spanish credit register with unique information on COVID PGL.

In brief, our results are the following. During the COVID crisis, we find that: First, ex-ante riskier firms and riskier banks participate more on PGL, while just the opposite happens

on non-PGL (private credit). Second, firms are substantially more likely to obtain a PGL from banks to which they have larger pre-COVID credit exposures, measured as the share of the firm's total credit outstanding with the bank before the shock. This effect is more pronounced for ex-ante risky firms and for firms in more pandemic-affected sectors, and this riskier lending is especially stronger by ex-ante riskier banks, with lower capital and higher nonperforming loans. The latter result is the opposite for non-PGL. Also, for a given firm, PGL loans have larger volumes and are granted at lower rates than non-PGL loans, especially the larger the pre-COVID credit share of the bank with the firm is. These results suggest a credit supply mechanism at play. Third, we show that the guarantee scheme results in credit substitution at the firm-bank level. For firms that obtain PGL from a bank, the share and amount of total credit of such bank in the firm increases, while the share and amount of non-PGL (private) credit of such bank declines, in part due to early prepayment of outstanding private credit and less ex-post loan delinquencies of outstanding private credit. These effects are stronger for ex-ante riskier firms and especially in conjunction by riskier banks. Overall, our results show that the allocation of government guaranteed credit is shaped by banks' private incentives, notably pre-existing bank-firm credit exposures, resulting on risk shifting of credit to riskier firms by riskier banks to taxpayers.

Our focus is on the Spanish public loan guarantee scheme established in March 2020 following the outbreak of COVID-19. We focus on Spain for four reasons. First, the Spanish scheme was one of the largest public guarantee scheme programs in terms of take-up amounts relative to GDP, accounting for most of new business lending (Falagiarda et al., 2020). Second, the Spanish scheme, in contrast to many other schemes, provided only a partial guarantee of up to 80% of the value of the loan, with residual credit risk being absorbed by the granting bank. This gives rise to an interesting role of banks' private incentives in lending decisions and the distribution of guarantees across firms as there is skin in the game for the bank but at the same time an important part of the loan is publicly guaranteed. Third, we have rich data at the loan-level from the Spanish credit register with detailed data on bank-borrower credit exposures. Finally, and most importantly, the Spanish dataset allows us to uniquely identify loans with COVID-19 related public guarantees, rather than generic public loan guarantees (different than e.g. AnaCredit). We conduct our analysis using loan-level data at the firm-bank level over the period December 2019 to June 2021.

A key question is what the main mechanisms underlying banks' distribution of guaranteed credit are, as they can affect the effectiveness and allocative efficiency of the guarantee scheme. Public guarantee schemes offer credit protection on part of the loan in exchange for a fee, which lenders pay to an administering agency, and typically come with eligibility criteria and lending requirements. While the guarantees are usually administered by government agencies on behalf of the government, the lending decisions are delegated to the lender and, hence, their allocation depends on *private banks' incentives*.

We study how different firm and bank level fundamentals shape the distribution of guaranteed credit, focusing on the relevance of pre-existing credit exposures between the bank and the firm. The effect of loan guarantees on bank lending and its interaction with pre-existing credit exposures is a priori not clear. Banks may prefer to grant guaranteed credit to pre-existing clients to preserve valuable relationships or to prevent defaults in their existing loan portfolios (Bolton et al., 2016). Firms may also prefer their main banks because of search costs involved in securing a guaranteed loan (Allen et al., 2019). Both channels predict that guaranteed credit would disproportionately flow to pre-existing clients especially those with larger credit exposures to the bank. On the other hand, credit guarantees, by limiting potential losses on existing loan portfolios and by improving loan repayment for less creditworthy borrowers, may reduce adverse selection in credit markets, prompting banks to seek out new customers and diversify away from their large exposure clients (Mankiw, 1986; Greenwald and Stiglitz, 1986; de Meza and Webb, 1987; Gale, 1990; and Innes, 1991). Moreover, loan guarantees, by acting as credit enhancement, provide an incentive to lend to firms that experienced a larger capital tightening (e.g., more directly affected by the COVID-19 shock) and that had weaker balance sheets to begin with (Freixas and Rochet, 2008). Guarantee schemes may also generate moral hazard by encouraging riskier lending at the margin (Kelly et al., 2016; Gropp et al., 2014). This effect should be especially stronger for weaker banks, with less skin in the game, i.e., those that are less capitalized and have more NPLs (Hellman et al., 2000).

First, we find that during the COVID crisis ex-ante riskier firms and riskier banks participate more on PGL. In particular, PGL are more likely to be granted to firms which are ex-ante riskier (worse ex-ante credit scoring),[1] smaller, with less liquid assets, and in negatively

[1] Altavilla et al. (2021) use defaults as of December 2019 as a measure of firm risk. As banks could not lend to firms with defaults just prior to COVID (as of December 2019), mechanically there would be a negative association between PGL and firm risk if one uses previous defaults as a firm risk measure. This difference implies

affected sectors by the COVID (e.g. tourism, transport, hospitality). In terms of bank characteristics, we find that PGL are more likely to be granted by banks with lower capital ratios and higher NPL ratios. For private (non-PGL) loans, just the opposite happens in terms of firm and bank risk characteristics –i.e., private loans are more likely associated to safer firms and by safer banks during the COVID crisis. These initial results are consistent with risk shifting behavior from the part of banks.

Second, we find that firms are more likely to obtain PGL from those banks with whom they have larger pre-existing credit exposures, measured as the share of the firm's total credit outstanding with the bank before the COVID-19, consistent with the role of banks' private incentives in exploiting the public guarantee scheme to address debt problems at the firm level. Interestingly, differently from pre-COVID bank-firm exposure, we find that banks are less prone to grant PGL to firms with which they have a longer relationship. This suggests that the results on the importance of lending relationships are due to incentives arising from credit (volume) exposures (as the model suggests) as opposed to informational advantages linked to the duration of lending relationships. Further, private loans (non-PGL) are also associated positively to banks to whom firms have larger pre-existing credit exposures but the economic effects are much lower than for PGL. In addition, and also different from our main result, firms which are more important for the bank (i.e. significant granular exposures for the bank) are associated to positive lending in PGL as well as private loans with very similar economic effects –if the firm exposure is quantitatively important for the bank, the bank will lend similarly with private and public loans.

Not only do we find that PGL are more likely to be granted to riskier firms and firms that are in sectors more negatively affected by the COVID crisis, but these effects are increasing in the pre-existing exposure between the firm and the bank, consistent with the relevance of bank's incentives in granting PGL. Similarly, not only do riskier banks (in terms of lower capital ratio and higher NPLs) grant more PGL, but especially do so to riskier firms both in terms of worse ex-ante credit score and in sectors more negatively affected by COVID. In addition, we find opposite effects on these margins on risk on non-PGL granting decisions; in particular, we find that, for higher firm-bank pre-COVID exposures, stronger (safer) banks

in part that our paper has significant differences with Altavilla et al. (2021) in terms of results. For all the differences, see below the discussion on the contribution to the literature.

provide more private loans to ex-ante riskier firms during the COVID period. All these results are again consistent with risk shifting behavior of risky banks in lending to risky firms by transferring high risk from private banks to taxpayers.

Moreover, PGL have larger credit volumes and lower loan interest rates than non-PGL. Further, the higher the share of the firm with the bank is, the stronger the impact of PGL on increasing credit volumes and decreasing loan interest rates. Therefore, results suggest a credit supply mechanism at play.

The economic effects of these first set of results are large. Results imply that an interquartile range increase in the firm's prior share of credit outstanding with the bank increases the probability of obtaining a PGL by that bank by 24.4%, while this increase is only 4% for non-PGL (private loans). Moreover, for PGL this increases to 32.5% for riskier firms (interquartile rage increase), to 27.4% for firms in adversely pandemic-affected sectors and to 40% for riskier firms in pandemic-affected sectors. Moreover, if the bank is lowly capitalized (interquartile range decrease) or has a high fraction of nonperforming loans (interquartile range increase), these effects increase to 43.6% and 42.9%, respectively. The granted loan amount for a given firm is 46% larger for PGL than for non-PGL, increasing to 57% larger if the firm's ex-ante credit share with the bank is high (interquartile range increase). Moreover, PGL on average have a 2.3 percentage points lower interest rate than non-PGL, which further decreases to 2.9 if the firm's ex-ante credit share with the bank is high (interquartile range increase).

Third, we analyze what the consequences of public credit guarantee schemes are for the performance of the overall credit market, in terms of credit substitution between public guaranteed and non-guaranteed credit, partly by both early repayments of loans and loan delinquencies of outstanding private credit. Public guarantees, by subsidizing risky credit, may provide incentives to substitute private credit risk with public guarantees (Gale, 1991), including through the early prepayment of loans or by reducing loan delinquencies.

We find that PGL result in credit substitution, with the share and amount of total credit in a given firm increasing for banks that grant a PGL to a firm, while the share and amount of non-guaranteed (private) credit declining. Interestingly, we find that, as suggested by our model, PGL granting decisions improve firms' repayment to the bank that grants the PGL, both in terms of higher early repayment of pre-existing loans and lower delinquencies of private

credit.[2] Our results highlight a relevant mechanism at play: the differential early repayment and delinquency behavior of loans from the same firm to banks that grant a PGL versus those that do not.

The economic effects on credit substitution are substantial: firms that have a PGL with a bank decrease their credit share of non-PGL with the bank by 7.8 percentage points and decrease their total amount of private (non-government guaranteed) credit amount with the bank by 15.4 percentage points over the sample period. Moreover, we find that banks that grant a PGL to a firm increase their overall credit exposure to the firm by 116.8 percentage points, resulting in a higher total credit share of the bank with that firm by 16.9 percentage points.

We also assess the role of maturity as it is easier to substitute loans that have shorter remaining maturity. For firms with a loan portfolio that has a lower residual maturity with the bank prior to the COVID-19 shock (equivalent to a decrease in its interquartile range), the credit share in terms of private (non-public guaranteed) loans decreases by 15.9 percentage points for firms with debt with shorter residual maturity, decreasing to 17.5 percentage points for riskier firms in more affected sectors and borrowing from lowly capitalized banks. These results are again consistent with risk shifting behavior to taxpayers.

The effect of early prepayment is also economically relevant: firms that receive a PGL from a bank increase the early repayment amount of loans (relative to firm total assets) to such bank in comparison to other banks with whom the firm has outstanding loans by 26.4% in the next six months since the PGL is granted. This figure increases to 51.5% for firms with shorter residual maturity, to 76% when, in addition, the credit share between the banks and the firm is high, to 108.9% when the firm is riskier, and to 194.9% when the bank is lowly capitalized. These results suggest that granting a PGL reduces the overall risk exposure of the bank to the firm as firms can use the PGL for the early prepayment of outstanding private loans. These results are again consistent with risk shifting form (riskier/weaker) private banks to taxpayers.

Regarding loan delinquencies, having a PGL with a bank reduces the likelihood of having delinquent loans with such bank in comparison to other banks with outstanding loans with the firm by 63.1%. Moreover, this increases to 72.6% when, additionally, the share between the

[2] While our stylized model is based on differential exposure of banks to firm repayment, it does not differentiate between repayment to different banks by the same firm as it assumes that the firm either repays all lenders or none.

firm and the bank is high (interquartile range increase), to 90.4% if the firm is risky (interquartile range increase), to 95.3% if the firm belongs to a negatively pandemic-affected sector, and to 143.6% when, in addition, the bank is lowly capitalized (interquartile range decrease).

Contribution to the literature. Our paper is part of an emerging literature on the effects and implications of government loan guarantees during the COVID-19 crisis. This literature has found conflicting results, with the effectiveness of guarantee programs in reaching the most vulnerable firms varying across papers. Several papers assess the impact of the U.S. pay protection program (PPP), which provided SBA-guaranteed loans to businesses to keep workers employed during the crisis. Granja et al. (2020) using loan-level data on PPP loans find that some funds flowed to geographic areas that were less affected by the crisis and that many firms used the funds for other than intended purposes. Using survey data, Humphries et al. (2020) find that PPP loans accrued disproportionally to larger firms instead of the intended more vulnerable smaller firms, reducing its effectiveness. Chodorow-Reich et al. (2021) using supervisory loan-level data find that smaller firms received PPP loans on less favorable terms. Altavilla et al. (2021) using the European AnaCredit dataset find that public loan guarantees were predominantly extended to smaller firms and led to a substitution of guaranteed for non-guaranteed loans.[3] Core and De Marco (2021) using Italian loan level data find that public guaranteed loans were disproportionately disbursed by larger and more technologically advanced banks. We confirm existing findings on credit substitution and on bank size as a key determinant in our Spanish dataset. We contribute to this literature by considering the role of banks' *private incentives* when loans are not fully guaranteed, focusing on the role of *existing credit exposures at the firm-bank level*, and by assessing the *consequences for the early repayments of nonguaranteed loans, and loan delinquencies*.

[3] Our paper has several different results as Altavilla et al. (2021) on the Spanish subsample. As written earlier, one part is due to the mechanical effect of using prior default as firm risk variable in Altavilla et al. (2021). In addition, with a different, simpler setting (comparing private loans vs. PGL), we find that riskier/weaker banks participate more in PGL, while safer/stronger ones participate more in private lending during the COVID period. Importantly, our results on risk shifting to taxpayers are stemming from weaker banks (less capitalized banks or with higher NPLs) in lending to riskier firms, while in Altavilla et al. (2021) results are stemming from stronger banks. In addition, we also analyze private loans and find that stronger banks provide loans to riskier firms. Moreover, we find a key role for private shorter maturity loans as a key mechanism for substitution (including to riskier firms by riskier banks), while in Altavilla et al. (2021), results are the opposite. Further, we assess the consequences for the early repayments of nonguaranteed loans and loan delinquencies. Moreover, the main difference of our paper to Altavilla et al. (2021) is that our results show that the allocation of government guaranteed credit are shaped by banks' private incentives, notably pre-existing bank-firm credit exposures.

Importantly, we show that the allocation of public loan guarantees depends on the magnitude of pre-existing credit exposures and that the substitution of public guarantee loans for non-public guaranteed loans results in a change in overall credit exposures between bank-firm pairs. We also provide novel evidence that granting a PGL increases the prepayment of pre-existing loans to the banks that grant PGL are less prone to get loan delinquencies on private credit by the firm that receives it. Both results suggest that the granting of guaranteed loans affects the repayment behavior of a given firm. Taken together, our results indicate that the loan guarantee scheme benefitted banks with pre-existing credit exposures, by allowing them to substitute nonguaranteed credit with less risky guaranteed credit, especially for the riskier, more negatively affected borrowers, and by enhancing the loan repayment capacity of existing borrowers. Overall, our results show that the allocation of government guaranteed credit are shaped by banks' private incentives, notably pre-existing bank-firm credit exposures, resulting on risk shifting of credit to riskier firms by riskier/weaker banks to taxpayers.

The paper continues as follows. Section 2 reviews related literature, other than recent literature on loan guarantee programs during Covid-19 already reviewed in the introduction. Section 3 provides institutional details on the Spanish loan guarantee scheme. Section 4 present a simple model to develop our testable hypotheses. Section 5 describes the data. Section 6 describes the empirical strategy. Section 7 presents the empirical results. Section 8 concludes.

2. Related literature

Our paper contributes to a large literature on the role of government interventions in credit markets. In the presence of frictions between borrowers and their lenders, government intervention can result in a more efficient allocation of resources, even if the government has no informational advantage over the lenders (Mankiw, 1986; Philippon and Schnabl, 2013; and Philippon, 2021). The reason is that without government intervention, credit rationing can occur, and government interventions could correct this market failure. Public loan guarantees are an important government intervention tool.[4] Their introduction can reduce the credit rationing that would otherwise occur when firms are hit by a negative shock. Consistent with this view, Bachas et al. (2021) find that more generous loan guarantees under the U.S Small

[4] Other examples include government-sponsored debt restructuring programs, such as the 2009 U.S. Home Affordable Modification Program (HAMP) which offered incentives to lenders to renegotiate mortgages and prevented foreclosures of highly indebted households (Agarwal et al., 2017), or direct lending by state-owned banks (Jimenez et al., 2020).

Business Administration (SBA) boost bank lending volumes. Related work has studied the implications of government-sponsored credit by studying the role of government-sponsored enterprises (GSEs) in U.S. mortgage markets. Loutskina and Strahan (2009) show that the secondary market activities of GSEs have boosted the securitization of mortgage loans, making mortgage markets more liquid. Elenev et al. (2016) develop a model where guaranteed mortgages are underpriced and enjoy favorable capital requirements to show that an increase in the price of the guarantee would result in fewer but safer mortgages, benefitting financial stability. Similarly, Jeske et al. (2013) develop a model with heterogeneous households to show that a reduction in the interest rate subsidy associated with the government bailout guarantee for GSEs would increase inequality by discouraging home ownership for poor households. Hurst et al. (2016) find that interest rates on mortgage loans securitized by GSEs are insensitive to regional variation in default risk, in contrast to non-GSE loans that are securitize in the private market. We contribute to this literature by focusing on the role of banks' private incentives in granting publicly guaranteed loans and showing that public loan guarantees disproportionately accrue to more vulnerable firms (riskier, smaller firms, and firms whose turnover is harder hit by the pandemic) after a negative exogenous unexpected temporary shock, thus providing implicit evidence of these government interventions help in increasing credit availability for firms. Importantly, we also contribute by showing that the allocation of public loan guarantees also depends on pre-existing credit exposures at the firm-bank level, especially to riskier, more negatively affected firms, consistent with the notion that government support measures interact with private bank incentives through bank lending relationships and bank incentives to shape the allocation of credit.

The literature on government interventions in the credit market has also highlighted how the introduction of government guarantees can, in some cases, distort the allocation of credit in a negative way by inducing excessive risk taking. The reason is that public guarantees, by affecting the valuation of bank investors and making them less subject to the negative consequences of declines in output (Merton, 1977), can increase the risk-taking incentives of banks. Gropp et al. (2014) show evidence of this effect analyzing the removal of deposit insurance guarantees for a subset of banks in Germany and how such banks differentially increase the risk of their loans. Wilcox and Yasuda (2019) analyze the impact of the introduction of loan guarantees for small business loans in Japan and find that they increase the risk taking of banks. We contribute to this literature by showing that the credit exposure of a firm to a given bank before the shock is a key determinant of the granting of public guaranteed

loans. This lending effect is stronger for riskier firms, and this riskier lending effect in turn is stronger for banks with riskier/weaker balance sheet strength (as measured by low capital ratio or high NPL ratio), consistent with the view that these banks are more subject to moral hazard issues (Holmström and Tirole, 1997). That is, our results show that the allocation of government guaranteed credit is shaped by banks' private incentives –notably pre-existing bank-firm credit exposures– resulting on risk shifting of credit to riskier firms by riskier banks to taxpayers.

Our paper relates to a large literature on the value and effects of lending relationships. The theoretical models in Sharpe (1990) and Rajan (1992) imply that lending relationships emerge to overcome informational asymmetries. These lending relationships can bring benefits to firms in terms of preferential access to credit, but they can also bring costs in the form of enhanced bargaining power of banks and associated hold-up problems. Consistent with this view, Berger and Udell (1995) using survey data from the U.S. Small Business Administration find that small firms with longer relationships enjoy more favorable lending terms, while Petersen and Rajan (1994) using the same dataset find that benefits accrue primarily in terms of the quantity as opposed to the price of credit. This literature has also shown that the value of relationship lending becomes pertinent during episodes of financial distress. Dahiya et al. (2003) using syndicated loan data show that the valuation of lending banks declines when their borrowers experience financial distress, while Bae et al. (2002) in the case of Korea find that the value of firms is adversely affected when their main bank experiences adverse shocks. Similarly, Carvalho et al. (2015) find, using syndicated loan data from 34 countries, that bank distress adversely affects the market values of firms with strong lending relationships. Bolton et al. (2016) using Italian credit register data find that relationship banks charge less favorable terms in normal times but offer larger quantities and more favorable terms to their relationship customers during crises. Schwert (2017) using syndicated loans data finds that better capitalized banks engage more in relationship lending. We contribute to this literature by showing that lending relationships are valuable in securing public loan guarantees during an exogenous economic downturn, and how this is especially true the higher the exposure of a bank to a given firm is, especially for riskier and more negatively impacted firms. We show moreover that the effects are stemming completely from the exposure (share) of a bank to a given firm just before the negative unexpected shock, but not from the (long-time) time since the bank started lending to the firm for the first time. Further, we show that firms that have significant (granular) lending exposures to a bank obtain similarly private loans (non-PGL) as

compared to PGL. Note, however, that the pre-COVID share of firm-bank credit is associated to more lending in PGL and non-PLG during the COVID period, but with substantially stronger economic effects for PGL. As our model and consistent evidence highlight, pre-existing bank-firm credit exposures are crucial in shaping banks' incentives.

3. The Spanish Loan Guarantee Scheme

The Spanish loan public guarantee scheme was announced and implemented in March 2020, following the outbreak of COVID-19 in the country. The government-sponsored program was set in place under the Royal Decree Law 8/2020 of March 17, with the aim to enable firms to draw on the funds needed to deal with the fall-out of the crisis brought about by the sudden emergence of COVID-19.[5] The public guarantee was intended to support the provision of public guaranteed credit up to 100 billion euros. Both companies and self-employed workers could access these guarantees through their banks, either by taking out new loans or by renewing existing ones. The public guarantee covered up to 80% of the amount lent for SMEs and self-employed; and for the rest of the companies, 70%, in the case of new loans, and 60% of the amount lent for the renewal of existing loans. The PGL cover a broad range of financing needs, including salary payments, vendor invoices pending settlement, rental of premises, and liquidity needs arising from the expiration of financial or tax obligations. Demand for PGL was high from inception of the program, with 70 percent of all PGL granted between April and June 2020. The guarantees are provided by the ICO (Institute of Official Credit) to the banks that grant the funding.[6] In exchange for issuing the government guarantee, the bank pays ICO a fee. Figure 1 offers an overview of the financial commitments and flows of the loan guarantee scheme among the various parties involved.

There are several exclusion criteria for participation in the public guarantee scheme.[7] Loans intended for the consolidation and restructuring of existing loans, as well as the

[5] See "Real Decreto-ley 8/2020, de 17 de marzo, de medidas urgentes extraordinarias para hacer frente al impacto económico y social del COVID-19", available in Spanish at: https://www.boe.es/eli/es/rdl/2020/03/17/8/con and https://www.boe.es/buscar/pdf/2020/BOE-A-2020-3824-consolidado.pdf.

[6] ICO is a state-owned bank, with an independent legal status, linked to Spain's Ministry of Economy and Business. It finances itself on the capital markets. The debt commitments and financial obligations it enters into with third parties benefit from the explicit, irrevocable, unconditional and direct guarantee of the Spanish State.

[7] See ICO website for further details on the guarantee scheme: https://www.ico.es/en-US/web/ico_en/ico/press_room/press_release/the-government-launches-the-guarantee-line-to-guarantee-the-liquidity-of-the-self-employed-and-companies.

cancellation or early repayment of pre-existing debts, are excluded from participation in the scheme. In addition, firms that had loans in arrears according to Spanish Credit Register (CIR) as of December 31, 2019, or that were subject to bankruptcy proceedings as of March 17, 2020, are excluded from these loans. Regarding the loan terms, the maximum eligible amount is 1.5 million euros in most occasions, the maximum loan maturity is 5 years (subsequently extended to 8 years with the Royal Decree 34/2020 of November 17, 2020) and the debtor's payment grace period is up to 12 months, subsequently extended to 24 months.

The guarantees are not free for banks and their customers. The cost of the guarantee amounts to between 20 and 120 basis points of the loan volume and is paid by the lending bank through the payment of a fee to ICO. Moreover, banks commit to maintaining the conditions of the new loans and renewals under the public guarantee scheme at the same level as applied before the COVID-19 crisis. With respect to loan interest rates, banks have an obligation to ensure that the costs of new loans benefiting from these public guarantees will remain in line with the costs charged before the start of the pandemic. This implies that the interest rate on loans that are renewed cannot be increased even if borrower risk has increased. The lending entities also commit to maintaining, at least until 30 September 2020, the limits of the revolving credit lines granted to all clients and, particularly, to those clients whose loans are guaranteed.

4. Hypotheses and Stylized Model

In this section, we provide a stylized theoretical model to explain under which circumstances the introduction of public loan guarantees affects the equilibrium of the loan market. We focus on identifying how both bank and firm characteristics, such as the exposure of a bank to a firm, how capital constrained the bank is, or the riskiness of the firm affect the granting of PGL. The main effect of loan guarantees is that they act as a credit enhancement, thus providing an incentive for particularly weaker banks, with less skin in the game, to lend to firms that experienced a larger capital tightening and had weaker balance sheets from the onset. The model also generates the empirical prediction that banks prefer to grant guaranteed credit to existing clients to prevent defaults in their existing loan portfolios, as in Bolton et al. (2016). We use this simple model to develop testable hypotheses to guide our empirical analysis.

Consider a one period risk neutral economy operated by a firm and two lenders, which we refer to as banks from now on. At date 0, the firm has pre-existing senior zero-coupon debt

of face value *D*. This debt is held by two different banks where $0<x_i<1$ is the proportion held by bank *i*. At date 1, if the firm succeeds, which happens with probability *p*, it produces *R>D*. When the firm fails it produces 0 and, given limited liability, does not repay its debt.

At an interim date, the firm receives an unexpected liquidity shock due to the pandemic. To continue operations, the firm needs an indivisible junior loan of quantity *L*. If such loan is not granted, we assume that the firm fails with probability 1.[8]

4.1 Private market: Existence

We first analyze under which conditions a private market for such liquidity (pandemic) loan would exist. The maximum payment that the bank that grants the loan can receive from the liquidity-pandemic loan is given by the pledgeable income of the firm *Y=R-D*.[9] This allows us to determine that a bank will have incentives to grant the loan as long as the expected income that the bank receives from the firm, which includes the expected repayment of previous debt as well as the expected repayment of the liquidity loan, is larger than the loan disbursement.[10,11]

Bank *i* has incentives to grant a (private) loan as long as

$$-L + p[Dx_i + Y] \geq 0,$$

which can be rewritten as

$$Dx_i \geq \frac{L}{p} - Y.$$

This condition states that a private loan is more probable to exist the higher the exposure of bank i to the firm, x_i. Such condition is more probable to hold when *p* is larger (safer firms) and *Y* is larger. This states that the private market is more prone to exist for safer firms and those that have higher expected returns. On the other hand, when the firm is riskier and has

[8] While the assumption of the loan being indivisible is made for simplicity, this assumption could be micro founded by assuming that the loan has some costs of observing the liquidity need that each bank has to bear.

[9] Note that in principle *Y* could be lower if we assume that the firm has some moral hazard problem at the firm level that limits full pledgeability of returns as in Holmström and Tirole (1997).

[10] The exact pricing of the loan is going to depend on whether both banks have incentives to grant a loan or not and the bargaining power between the loan and firm. For now, we assume that the bank is able to extract all of the pledgeable income of the firm *Y*.

[11] In this formulation, we implicitly assume that the bank assumes that if it does not grant the loan the other bank would not grant it either, i.e. that the firm can only approach one bank. In Appendix B, we extend this basic setup to incorporate the strategic decision of banks, i.e. that firms can approach all banks, and show that the main conclusions do not vary.

lower expected returns (for instance, because it is more negatively affected by the pandemic), it is more probable that the bank does not have an incentive to extend the loan. In such case the private market would not exist, resulting in the failure of the firm.

4.2 Public guaranteed loans: Existence

We now turn to analyze how loan granting decisions are affected by the introduction of a public guarantee loan scheme, which is a key aspect of our paper. We assume that the government introduces the possibility of banks granting PGL. In a PGL, by paying a fee F to the government the government repays a fraction $0<g<1$ of the granted amount L to the bank if the loan defaults.

A bank would grant a PGL when doing so results in higher profits than granting a private loan, and at the same time the PGL has a positive NPV for the bank. These two conditions can be expressed as

$$-L + p[Dx_i + Y] - F + (1-p)gL \quad \geq -L + p[Dx_i + Y] \text{ and}$$

$$-L + p[Dx_i + Y] - F + (1-p)gL \quad \geq 0$$

The first condition, which states that granting a PGL is preferred to granting a private loan, can be rewritten as:

$$-F + (1-p)gL \ \geq 0.$$

Such condition states that the PGL would be granted instead of the private loan, whenever the value of the guarantee is positive. Rearranging, this occurs when

$$p \leq 1 - \frac{F}{gL},$$

which states that PGL are only going to be granted for a sufficiently risky firm. This holds because the value of the guarantee accrues only upon default of the firm.

At this point, it is relevant to note that there are two different cases in which the PGL is granted. The first one is a situation in which the private loan would also have existed, which is the case when the following condition holds

$$-L + p[Dx_i + Y] - F + (1-p)gL \ \geq \ -L + p[Dx_i + Y] \geq 0.$$

In such case, the PGL would only be substituting the private market of credit.

However, there is a second case in which the PGL has a positive NPV but the private loan does not. This occurs when the following condition holds

$$-L + p[Dx_i + Y] - F + (1-p)gL \ \geq 0 \geq \ -L + p[Dx_i + Y].$$

In such case, the inclusion of the PGL has the positive effect of allowing a loan to be granted when the private market was not operating. These are the circumstances in which PGL have a positive effect on overall amount of credit.

From now on we focus on this later case as the main objective of the PGL scheme introduced in Spain was to support overall lending.

4.3 Public guaranteed loans: Comparative statics

We now turn to developing our main testable hypotheses by analyzing which bank and firm characteristics make a PGL more probable to be granted. We focus on understanding the effects of bank exposure, *x*, firm's riskiness, *p*, and the capital constraints of banks.

Under the previous condition, i.e., that the PGL scheme expands credit, the relevant condition that determines if a PGL is granted is that it has a positive NPV for the bank

$$-L + p[Dx_i + Y] - F + (1-p)gL \geq 0,$$

which allows us to determine that a bank would have incentives to grant a PGL as long as

$$Dx_i \geq \frac{[1-(1-p)g]L + F}{p} - Y.$$

This expression highlights how granting a PGL is more probable the higher the exposure bank i to the firm, x_i.[12]

More specifically, we can define

$$D\bar{x} = \frac{[1-(1-p)g]L + F}{p} - Y$$

[12] As previously shown, when the PGL do not expand the loan market, then the only relevant determinant of granting a PGL versus a private loan is the value of the guarantee, which is independent of the exposure of the bank.

as the minimum exposure that a bank has to have with a firm in order to have incentives to grant a PGL. This determines that, only banks with high enough exposure to a firm have incentives to grant a PGL.[13] From this follows our first testable hypothesis:

Hypothesis 1: The granting of guaranteed loan is increasing in the ex-ante loan exposure of the firm to the bank.

By analyzing how does the exposure threshold, $\bar{x}$, varies with p we can determine when the exposure of a bank is a more crucial determinant in granting a PGL. Note that the larger the $\bar{x}$ the lower the range of x such that both banks have incentives to grant the loan, and also the lower the range of x such that the bank with the larger exposure has incentives to grant a loan. Specifically, we can obtain how

$$\frac{d\bar{x}}{dp} = \frac{gLpD - D[1-(1-p)g]L - F}{p^2D^2} < 0.$$

Hence, the safer the firm the lower the necessary threshold for a bank to grant the PGL. In other words, the exposure of a given bank x is more determinant to grant a PGL the riskier the firm.

Similarly, we can obtain how a decrease in the firm's pledgeable income Y, which can capture if the firm belongs to a sector that is more affected by the pandemic, makes the exposure threshold increase. Specifically, we can obtain that

$$\frac{d\bar{x}}{dY} = -\frac{1}{D} < 0.$$

Hence, the lower the pledgeable income of the firm the more relevant the higher the exposure needed in order to grant a PGL. This leads to the next hypothesis:

Hypothesis 2: The positive effect of the ex-ante loan exposure on the granting of guaranteed loans is stronger the riskier (or more affected by the pandemic) the firm is.

One further issue that is affected by the introduction of the public guarantee is the regulatory risk weight of the loan and thus the capital constraint of the bank. Effectively, by

[13] Whenever $\bar{x}$=([1-(1-*p*)*g*]*L*+*F*)/*pD*-*Y*/*D*<0.5, there would be circumstances in which both banks have incentives to grant the PGL. Those circumstances are the ones in which the bank with the lowest exposure x_l has 0.5> x_l >$\bar{x}$. For those cases we could assume that bank grants the loan either in a purely random manner of in proportion to the ex-ante weights (as they might capture some hidden costs). Irrespective of the underlying assumption, in such cases the holding of a given bank x would not be as crucial a determinant in the granting the PGL, as both banks have incentives to grant a loan, as when only one of the banks has incentives to grant the loan x_l <$\bar{x}$< x_h =1- x_l.

guaranteeing part of the returns of the loans, PGL have a lower regulatory risk weight, and hence lower required regulatory capital than private loans to the same firm.

To capture the relevance of this effect we further assume that banks can differ in how constrained they are in their capital. Let us assume that there are two types of banks: those that are capital constrained and those that are not. A capital constrained bank must forgo some positive NPV investments, with value Δ for each unit of regulatory capital dedicated to the loan, while a capital unconstrained bank does not have to forgo such investment. We assume that a PGL reduces the regulatory capital from k to k' and in doing so reduces the investment forgone by capital constrained banks.

We can show that, while the value of a PGL for a capital unconstrained bank is the same as the one already explained,

$$-F + (1-p)gL,$$

the value of a PGL for a capital constrained bank can be expressed as

$$-F + (1-p)gL + \Delta(k-k'),$$

where the third term of the previous expression is the value of the regulatory capital savings. By comparing the two expressions we can conclude that for banks that are capital constrained the incentives to grant a PGL are larger as they can save on costly capital. This effect would be larger the larger the regulatory capital savings that the constrained bank would obtain (for example, for riskier firms in a risk weighted capital requirement framework). This leads us to the third hypothesis:

Hypothesis 3: The granting of a guaranteed loan is more likely for poorly capitalized banks, and this effect is stronger for lending to riskier (or more affected by the pandemic) firms.

As we have already discussed in section 4.2, PGL can have a direct substitution effect on private credit for cases in which the PGL involves a subsidy and the private loan would have existed. Also, the expansion of credit resulting from the introduction of a public guarantee scheme has direct implications for the proportion of nonguaranteed credit in overall credit, with this proportion decreasing the more likely it is that banks grant PGL. The public guarantee scheme will create a strong incentive to shift credit risk onto PGL by using the proceeds of PGL for the early prepayment of unguaranteed outstanding credits, thus preventing a default

on such credits. This incentive will be stronger for firms and banks with binding capital constraints. The following hypothesis follows:

Hypothesis 4: The granting of guaranteed loans will result in credit substitution, with the proportion of nonguaranteed (private) credit declining for firms that obtain guaranteed loans, in part reflecting early prepayment of outstanding private credit.

In our setup the granting of PGL directly reduces the delinquency of loans as it provides firms with the necessary resources to overcome the negative shock. In addition to this effect, the above discussed effect of PGL on the early prepayment of nonguaranteed credit reduces the private risk exposure of banks to those firms. As a result of this improved risk profile from both channels, banks are less likely to have delinquent loans to firms that receive PGL. The tendency for PGL-granting banks to have less delinquent loans should be stronger for weakly capitalized banks. This follows directly from the regulatory capital constraint mechanism in the model. Banks with binding regulatory capital constraints have a greater incentive to grant PGL in order to save on regulatory capital. One way to save on regulatory capital is by the loan not being delinquent. The following testable hypothesis follows:

Hypothesis 5: The granting of guaranteed loans will result in a reduction in the proportion of loans being delinquent, especially for weakly capitalized banks.

5. Data description

We combine four different data sources: (i) the Spanish Credit Register (CIR), (ii) loan application data of firms to non-current banks, (iii) supervisory bank balance sheet information, and (iv) firm balance-sheet information from the Spanish Mercantile Registers collected by the Banco de España.

Our main database come from the credit register owned by Banco de España which contains granular information at loan level since 1984 and at a monthly frequency of all type of loans, firms and banks operating in Spain. The CIR is a comprehensive database with a very low threshold (almost 0, which makes it a census) that includes information of the loan such as the type of instrument, amount (drawn and undrawn), degree of collateralization, maturity, currency, interest rate, grace period, default status. From the CIR we are able to construct exhaustive information on the credit exposure of all firms with all of its banks. This is particularly relevant as our variable of interest is the share of total credit outstanding that the firm has with a bank just before the eruption of the COVID-19 pandemic and its evolution over

time. The CIR also provides some information about the borrower such us its identity, industry (at NACE 3 digits), location (at zip-code level) and size. In terms of the lender, the CIR has information on the bank identity. This firm and bank identification allows us to match each loan to firm and bank characteristics from the Spanish Mercantile Register and supervisory bank balance sheet information.

Importantly for our purposes, the CIR has detailed information on any loan guarantees, and in particular on whether the loan has an ICO guarantee as part of the Spanish pandemic loan guarantee program. This information is a clear advantage of the Spanish credit register as we use it to construct an indicator variable for whether the loan has an ICO guarantee or not. For example, the European credit register Anacredit does not have this information.

We also exploit information on loan applications from the CIR. At monthly frequency, a bank receives automatically from the Banco de España information about their current borrowers' exposure. Additionally, banks can request this information from the Banco de España for their potential borrowers with their consent (Jiménez et al. 2012; Jiménez et al. 2014). We take such individual requests from banks on potential borrowers as a clear indication that, in general, the firm is searching for a loan and that, specifically, it has asked the bank for a loan. This information is stored monthly by the Banco de España since 2002. We use this information on loan applications, joint with granted loans, to capture firms that have actively sought funding during the pandemic.[14]

The economic and financial information of firms is collected from the balance sheets and income statements that Spanish firms must submit yearly to the Spanish Mercantile Register. We use the unique firm identifier (CIF) to merge this information with the credit registry. We also have information at bank level of the balance sheets and income statements that banks are required to report monthly to the Banco de España in its role as banking supervisor. We merge this information using the bank identifier which is in both databases.

We restrict our analysis to non-financial corporations and the sample period to 2019:12-2021:06, so that we contrast the evolution of lending immediately before and after the introduction of the Spanish loan guarantee scheme in March 2020. We exclude from the sample firms that are not eligible for participation in the ICO guarantee scheme, either because they

[14] Our loan application data does not distinguish between applications for PGL or non-PGL.

were undergoing loan restructurings or bankruptcy proceedings, or because they had loans in arrears as of December 31, 2019.

6. Empirical Strategy

We perform alternative empirical analyses to test the hypotheses developed in section 4 and provide answers to the following three sets of questions: i) What firms/banks are more likely to participate in the public loan guarantee scheme as opposed to private loans (non-PGL)?; (ii) Does larger ex-ante loan bank-firm exposure affect differently PGL vs non-PGL, and do effects change for riskier firms and banks? To understand credit supply effects, are the conditions of PGL different from those of non-PGL, in particular in term of loan amounts and loan interest rates?; iii) Is there a substitution of non-public guaranteed for public-guaranteed loans among banks that grant a public guaranteed loan to a firm? If so, is it stemming from earlier repayment and less delinquencies of private loans? How do these effects change for riskier firms and banks?

Importantly, in each of the analyses we study the relevance of pre-existing lending relationships in shaping the observed relations. Specifically, we focus our analysis on the relevance of the ex-ante loan exposure that a firm has with a bank, proxied by the share in terms of the firm's total loans as of December 2019.

To answer the first question, we construct a dataset at the firm-bank level to capture firms that have actively sought funding during this particular time period. We first identify all firm-bank pairs in the CIR in terms of new financing transactions granted, or loan applications made to non-current banks, between March and December 2020. Then, for those firms identified in the previous step we also consider all banking relationships as of December 2019, to account for the possibility that if a company seeks a loan it will likely probe the banks with which it has a prior relationship. We pool the observations at the firm-bank level for the considered period, so that we have only firm-bank pairs in the sample. This allows us to include firm and bank fixed effects to account for unobservables. This database includes 128 banks and around 200,000 firms, and results in 718,000 (firm-bank) observations. With this database we are able to investigate what firm, bank and firm-bank characteristics make a company more likely to get a PGL from a bank between March and December 2020. As already discussed, one of our main objectives is to focus on the relevance of the ex-ante credit exposure of the firm with a given bank just before the pandemic.

We first consider the following regression specification to analyze the extensive margin estimated by OLS as a linear probability model:

$$PGL_{ij} = \beta_0 Share_{ij} + \beta_1 Firm_i + \beta_2 Bank_j + \beta_3 Firm\text{-}Bank_{ij} + \eta_i + \eta_j + \varepsilon_{ij} \quad (1)$$

where PGL_{ij} is an indicator variable denoting whether the firm has a public guaranteed loan with the bank or not, i refers to firms and j refers to banks. We are interested in the coefficient on the $Share_{ij}$ variable, which captures the share of the firm with the bank in terms of the amount of the firm's credit as of December 2019. This variable allows us to understand whether, in line with hypothesis 1, prior lending relationships are a key driver to obtain a PGL. Share is predetermined to the COVID shock and, in line with the literature on banking relationships, is stable over time before this shock. We are exploiting the unexpected (negative COVID) shock on this "predetermined" variable to analyze how bank lending relationships affect lending and risk taking differentially for PGL and non-guaranteed loans.

We are also interested on whether firm and bank risk characteristics are associated to PGL. $Firm_i$ is a vector of firm variables that include firm ex-ante credit risk (captured by a scoring measure with higher values meaning more risk)[15], a dummy for more severely affected sectors by the pandemic (defined as those whose turnover decreased by more than 15% in 2020), the size of the firm (proxied by a SMEs dummy)[16], its liquidity (as the fraction between cash and other liquid assets over total assets of the firm). $Bank_j$ refers to a set of bank variables that includes bank capital ratio (defined as the ratio of own funds over total assets), the NPL ratio (defined as the ratio of non-performing loans, doubtful and 90 days overdue, over total loans of the bank), its liquidity position (defined as the ratio of liquid assets over total assets) and the size of the bank (defined as the log of total assets). We also include the average residual maturity of loans outstanding between the firm and the bank as an additional control in the $Firm\text{-}Bank_{ij}$ vector. In some specifications we also control for firm (η_i) and bank (η_j) fixed effects that account for observable and unobservable time-invariant firm and bank factors.

[15] The scoring function synthesizes a battery of firm financial and non-financial ratios in a sufficient statistic of the solvency of a firm. based on 18 firm variables such as debt-term structure; average cost of debt; capital ratio, ROE, ROA and sales' profitability; industry; age; bank loan defaults, etc. Each of the firms' variables is assigned to a specific area: financial indebtedness, solvency, liquidity, profitability, business information, and default history. Moreover, each variable is categorized in six intervals and a different rating value is assigned depending on the allocation to each of the buckets. Then, each rating value is weighted inside its corresponding area, and each of the six areas is again weighted to get the final score, which is the weighted sum of the ratings assigned to the different characteristics. Ratings are such that the (risk) score is increasing in the firm's credit risk.

[16] Based on the definition of the Commission Regulation (EU) No. 651/2014, of June 17, 2014.

Finally, ε_{ij} is the error term. All firm and bank explanatory variables are measured as of December 2019, before the unexpected COVID shock. Standard errors are multi-clustered at the firm and bank level to allow for serial correlation across firms and banks.

To analyze differences in the likelihood to obtain non-PGL (private loans), we run the same exercise but replace the dependent variable by one capturing whether the firm only obtained a non-PGL during the sample period. In the Appendix, we also check the stability of the results conditioning on banks that granted a loan (PGL or not) to a firm. There are firm-bank pairs with a PGL, or a non-PGL, or without any credit during our COVID sample period. We can do this, as explained earlier, as our dataset come from associating banks to firms with loan applications during the COVID period, or with granted credit in the COVID period, or with previous bank-firm lending exposures, i.e. effectively we have the pool of potential lenders for each firm that have positive credit before COVID as of December 2019.

Second, we are interested in analyzing whether the effect of the loan share variable (proxying for bank incentives) on the likelihood to obtain a PGL is more pronounced for ex-ante riskier firms and/or banks as stated in our hypotheses 2 and 3. To capture this possibility, we estimate a model where we include double and triple interactions terms of the *Share* variable with the firm risk scoring variable and the severely affected sector dummy, from the firm side, and the capital ratio and NPL ratio, from the bank side. The enriched regression specification is as follows:

$$PGL_{ij} = \beta_0 Share_{ij} + \beta_1 Share_{ij} * \begin{pmatrix} Risk_i \\ Affct.sector_i \end{pmatrix} + \beta_2 Share_{ij} * Risk_i * Affct.sector_i + \beta_3 Share_{ij} * Risk_i * Affct.sector_i * \begin{pmatrix} Bank\ capital\ ratio_j \\ Bank\ NPL_j \end{pmatrix} + \varphi_{ij} + \eta_i + \eta_j + \varepsilon_{ij} \quad (2)$$

where φ_{ij} is a vector of variables that contains the rest of the interactive terms of lower degree not showed. Moreover, it also includes quadruple interactions of the other bank controls (including lower degree terms) to mitigate concerns about omitted variables. With this specification we can evaluate whether riskier banks lend more to riskier firms after the COVID shock using PGL. If this was the case, we would expect the estimated betas to be all positive and statistically significant, except for the one on *Share*Risk*Affected sector*Bank capital*,

that we would expect to be negative and significant.[17]Table 1 presents summary statistics of the main regression variables. Just over a third of the observations (37.8%) have a PGL during the analyzed period, while 28.7% of all firm-bank pairs only have non-PGL. A total of 95% of all observations correspond to small and medium-size firms (SMEs) and 62% belong to the sectors considered as severely affected by the pandemic. The average value of the Share variable is 26.6% and its median is 13.6%. Appendix Table A1 presents the definition of the main regression variables.

Turning to the loan-terms of granted loans analysis, i.e., the amount granted or the interest rate applied, we construct a database of new loans granted from 2020:03 to 2020:12. For every firm and bank we collapse all new loans in two types: PGL and non-PGL. As a result, we obtain a database at the firm-bank-type of loan level. The dataset has more than 620,000 observations and allows us to control for firm*bank fixed effects.

Using such database we estimate the following equation:

$$Loan\ conditions_{ijk} = \beta_0 PGL_{ijk} + \beta_1 PGL_{ijk} * Share_{ij} + \eta_{ij} + \varepsilon_{ijk} \qquad (3)$$

where *k* refers to the loan type and PGL is a dummy that equals 1 for public guaranteed loans, and 0 for private (non-PGL) loans. The previous equation is the most saturated one due to the inclusion of firm-bank fixed effects. In the tables we also show the estimation results of similar models that includes only bank and firm fixed effects. In Eq. (3) the coefficient on PGL is capturing the differential effect on the committed amount or the interest rate charged of the granted loan being a PGL, while the interaction captures whether the effects depend on *Share*. In this way we can analyze whether our results are more consistent with a credit supply rather than demand channel. For the analysis of the loan amount granted, Eq. (3) is estimated using a Poisson model in order to reduce possible biases arising from a classical log linear estimation

[17] In the Appendix, we show some robustness exercises on the share and risk variables. First, we replace the share variable, inter alia, with a dummy variable that captures whether the bank is the main lender of the firm as of December 2019 to show that the relationship of the *Share* variable is robust. Second, we replace the risk variable with the bad credit history of the firm before December 2019 (note that mechanically a firm with defaults as of December 2019 cannot get PGL). We also study if the results are robust to focusing on high risk firms, defined as those in the higher decile of the distribution of the risk variable. Finally, it is possible that the results were affected by some seasonal effects that occurred on a recurring basis after March. We therefore analyze the likelihood of getting a new credit in 2019 for different treatment periods, as a falsification test. In addition, not only do we analyze the exposure of a bank to a given firm just before the negative unexpected shock, but also from the (long) time since the bank started lending to the firm for the first time. Further, we also analyze the importance that firms that have significant (granular) lending exposures to a bank have in obtaining private non-public guaranteed loans as compared to PGL.

(see Santos Silva and Tenreyro, 2006). When the left-hand-side variable is the interest rate, Eq. (3) is estimated by OLS. As before standard errors are clustered at the firm and bank level. Table 1 also provides the descriptive statistics of these dependent variables. The loan amount has an average value of 129,649 euros with a median of around 60,000 euros. The average new loan has an interest rate of 3.3%.

Third, we analyze whether banks that grant a PGL reduce their exposure to non-PGL, and if so, whether early repayment of private credit and lower delinquencies are part of the associated effects. To estimate this substitution effect, we analyze the evolution of outstanding credit between two dates (2019:12 and 2021:06), an event (the COVID-19 pandemic that started in March 2020) and banks that grant a PGL to a firm versus those that do not. Using this approach, we measure the change in the share of the firm with a bank both for non-PGL and total loans stemming from the introduction of the loan guarantee program due to the pandemic. We do so by comparing the evolution of the *Share* (left-hand-side) variable in firm-bank pairs that have a PGL. As before, the *Share* variable is computed using the credit amount of a firm with all its banks in two periods of time: before and during the pandemic. We compute the change in share based either on total loans or on non-PGL only. We have a dataset at firm-bank level with around 6,700,000 observations, covering 178,000 firms and 130 banks, that allow us to estimate by OLS the following model:

$$\Delta Share_{ijt} = \beta PGL_{ij} + \eta_i + \eta_j + \varepsilon_{ijt}. \qquad (4)$$

We construct our key right-hand-side variable (PGL dummy) as the product of a time dummy (which refers to the start of the pandemic, March 2020, and later dates), and a firm-bank dummy (which refers to a firm *i* that obtained a PGL from bank *j* before *t*). PGL dummy variable, which for simplicity does not have the subscript *t*, captures if that bank-firm pair had a PGL before date *t*. We start by estimating the model with only zip code fixed effects, to progressively saturate it with fixed effects until we arrive at Eq. (4), which includes bank and firm fixed effects. The coefficient β on PGL captures the impact on the change in the share (of both non-PGL and total loans) of a firm with a bank that granted a PGL to that firm with respect to those that did not. A negative coefficient of PGL on non-PGL share and a positive coefficient on total loans would be evidence consistent with credit substitutions as stated in our hypothesis 4. We also exploit the differential intensity since PGL have different amounts. Moreover, we also analyze the change in the credit amount of the firm with the bank.

We also study the heterogeneous effects across different firm and bank risk characteristics in our variable of interest. As effects of substitution could depend on residual maturity of existing (private) loans between a bank and a firm, we interact this variable with PGL and with heterogeneous effects across different risk measures. We do this by estimating the analogue of Eq. (4) that includes additional interaction terms. The equation then takes the following form:

$$\Delta Share_{ijt} = \beta_0 PGL_{ij} + \beta_1 PGL_{ij} * Firm\text{-}Bank_{ij} + \varphi_{ij} + \eta_i + \eta_j + \varepsilon_{ijt} \qquad (5)$$

where $Firm\text{-}Bank_{ij}$ is a vector of firm, bank and firm-bank characteristics similar to previous equations, where we now include residual maturity. We control for the vector of variables (φ_{ij}) that contains the rest of the interactive terms of lower degree (not showed).

Additionally, to better understand how this substitution is taking place, we carry out first an analysis of the extent to which non-PGL are repaid in advance after obtaining a PGL and/or second whether those firms default on less.

We construct a variable that measures the early repayment amount of a firm with a bank in the months following the granting of a PGL. This analysis is conducted on a database that is constructed at the firm-bank-year:month level for the period 2020:03 to 2021:06. In particular, we estimate by OLS the following equation:

$$Cumulative\ early\ repayment/Assets_{ijt} = \beta_0 PGL_{ij} + \beta_1 PGL_{ij} * Firm\text{-}Bank_{ij} + \varphi_{ij} + \eta_{it} + \eta_{jt} + \varepsilon_{ijt}. \quad (6)$$

where the cumulative amount of early repayment in the next *x* months (from 1 to 6) is expressed in terms of the firm's total assets as of December 2019; η_{it} are firm*year:month fixed effects; and η_{jt} are bank*year:month fixed effects, which controls for both time-invariant and time-varying observed and unobserved firm and bank characteristics, respectively. If the estimated coefficient on β_0 is positive and significant it would be evidence that firms are early amortizing private credit after obtaining a public guaranteed loan, consistent with our hypothesis 4.[18] We also analyze the heterogeneity of the PGL effect on firm early repayment with firm-bank characteristics including residual maturity and firm and bank ex-ante risk.

[18] For robustness, we also compare the early repayment after a PGL with that produced after a non-PGL (see Appendix).

Regarding delinquencies, we carry out a separate analysis that exploits the same data set used for the substitution analysis. We are interested in investigating whether banks that granted a PGL to a firm are less likely to have delinquent loans from such firm. The proposed model takes the form:

$$Delinquent_{ij} = \beta_0 PGL_{ij} + \beta_1 PGL_{ij} * Firm\text{-}Bank_{ij} + \varphi_{ij} + \eta_j + \varepsilon_{ijt}. \quad (7)$$

where *Delinquent* is a dummy that equals 1 if the bank classified a firm as having delinquent loans sometime from 2020:03 to 2021:06, and 0 otherwise. We estimate Eq. (7) by OLS as a linear probability model. Given that we are including firm fixed effects, we can compare the same firm with at least two different banks. Therefore, if the coefficient β_0 is negative and statistically significant there is evidence, consistent with our hypothesis 5, of different loan delinquencies depending on whether the bank granted a PGL to the firm or not. The fact that PGL loans had a repayment moratorium in place during our sample period suggest that all the differences in delinquencies happen because of differences in repayment of private credit. As before, we also do the heterogeneity analysis with firm and bank ex-ante risk measures.

7. Results

This section provides the results of our analysis. We first document in Section 7.1 what are the key determinants driving the allocation of public guaranteed loans. We start by analyzing loan granting decisions at the firm-bank level and, then analyze for granted loans their amount and interest rates at the type of loan-firm-bank level. We then document in Section 7.2 the effects of such allocation of public guaranteed loans in terms of credit substitution between publicly guaranteed and non-publicly guaranteed credit. We also analyze the role played by both early prepayment and delinquencies of outstanding private credit.

7.1 Allocation of credit: Loan granting decision

The results on the analysis of obtaining a PGL are presented in columns (1) to (5) of Table 2. The analysis is conducted at the firm-bank level. Regressions include an increasingly richer set of fixed effects as one moves across the table columns (keeping the sample fixed to avoid composition effects), with the regression in column (5) including firm and bank fixed effects.

We find that PGL are more likely to be granted to risky firms (based on ex-ante credit risk scoring), firms in more negatively affected sectors by the pandemic (e.g. tourism, transport,

hospitality), SMEs and firms with less liquid assets. This indicates that, as suggested by our theoretical framework, there is an association between PGL extension and firms' risk. In terms of bank-firm characteristics, we find that PGL are more likely to be extended by banks to firms with a higher ex-ante loan share with the bank, in line with our hypothesis 1, and that have higher residual maturity on outstanding loans with the firm. Moreover, we find that PGL are more likely to be extended by banks with lower capital ratios and lower return on assets (ROA), by banks with higher NPL ratios, and bigger banks. This indicating that, as stated in hypothesis 3, there is an association between PGL extension and bank risk/weakness.

The remainder of Table 2 presents results for non-PGL (private loans). Specifically, we find that the *Share* variable obtains a much smaller coefficient (0.03) when compared with the results for PGL (0.22). In terms of economic relevance, an interquartile range increase in the firm's prior share of credit outstanding with the bank increases the probability of obtaining a PGL by 24.4% (0.216*(.429-.003)/0.378*100), comparing with the 4% for non-PGL (0.027*(.429-.003)/0.287*100). This highlights that while, as our model suggests, *Share* is a relevant determinant of granting private credit, it is much more so for public credit. Importantly for non-PGL, the firm and bank variables have the opposite sign (and statistically significant) than for PGL.

In sum, we find that, during the COVID crisis period, ex-ante riskier firms and riskier banks participate more on PGL. In particular, PGL are more likely to be granted to firms which are ex-ante riskier and in negatively affected sectors by the COVID. In terms of bank characteristics, we find that PGL are more likely to be extended by banks with lower capital ratios and higher NPL ratios. Just the opposite in terms of firm and bank risk characteristics happens for private loans (non-PGL) –i.e., during the COVID crisis private loans are more likely associated to safer firms and by safer banks. These initial results are consistent with risk shifting behavior from the part of banks. Moreover, we find that firms are much more likely to obtain PGL (also as compared to private loans) from those banks to whom they have larger pre-existing credit exposures, consistent with the role of banks' private incentives in exploiting the public guarantee scheme to address debt repayment problems at the firm level.[19]In Table 3,

[19] Results presented thus far also include loan applications that did not result in the granting of loans. We obtain similar results when limiting the sample by conditioning only on granted loans, presented in Appendix Table A2, Panel A. These estimates show the differential effects between granted PGL and non-PGL and highlight the different loan granting strategies followed in PGL and non-PGL conditional on a loan being granted.

we estimate heterogeneous effects of the *Share* variable depending on pre-determined bank and firm characteristics based on the more demanding specification with firm and bank fixed effects. The heterogeneous results for the granting of PGL indicate that, in line with hypothesis 2, the positive effects of the *Share* variable are more pronounced for risky firms and for firms in affected sectors, as well as for banks with lower capital ratios and higher NPL ratios. The regressions for non-PGL presented in columns (6) to (10) of Table 3 obtain much smaller effects of the *Share* variable and the opposite sign for its interaction with risky firms and banks.

The economic effects of the results in Table 3 are substantial. The heterogeneous effects estimated in Table 3 imply that the probability of obtaining a PGL increases by 32.5% for risky firms (interquartile rage increase), by 27.4% for firms in adversely pandemic-affected sectors and by 40.0% for risky firms in pandemic-affected sectors. If the bank is lowly capitalized (interquartile range decrease) or has a high fraction of nonperforming loans (interquartile range increase), these effects on riskier firms in PGL increase by 43.6% and 42.9%, respectively. Instead, in non-PGL (private loans), stronger/less risky banks grant more loans to riskier firms in negatively affected sectors by the COVID. Therefore, these results suggest risk-shifting to taxpayers of risky credit (to riskier firms) by riskier banks (with ex-ante weaker bank balance sheets).

Results are robust, in addition to fixed effects and controls shown in Table 3. For example, as before, the differential effects for granted loans are presented in Appendix Table A2, Panel B, with similar results. Results in Appendix Table A3 show that the results so far are robust to alternative measures of the exposure of a firm with a bank (the *Share* variable) and to how we measure firm risk. In Panel A, we replace the *Share* variable with a main bank dummy, which equals 1 if the bank was the main lender of the firm in 2019:12 (in terms of total amount of credit committed) and 0 otherwise. The results in Panel B are obtained after replacing the risk variable with bad credit history, which is a dummy variable that takes a value of 1 if the firm experienced some loan default in the past before December 2019 and 0 otherwise. Panel C replaces the risk variable by its highest decile (denoted High risk). In each of these cases we obtain qualitatively similar results as in our baseline specification.

In Appendix Table A4, we perform a falsification test to make sure that the effect of the *Share* variable is specific to PGL and derives from the pandemic period, and not to possible seasonal effects. Specifically, this table reports regression results of a linear probability model

at firm-bank level of the probability of a firm to get a loan (of any type, being guaranteed or not). We consider different time periods to address concerns that the effect of the *Share* variable analyzed in the period 2020:03-2020:12 may be picking up seasonal effects other than the COVID-19 pandemic. Post is a dummy that equals 1 for the months after the reference date until December of that year. We find that there is no significantly different effect of the *Share* variable on the likelihood of receiving a loan between periods before COVID-19 suggesting the inexistence of relevant seasonal effects.

Next, we consider two alternative dimensions of lending relationships: granularity and duration of lending relationships. A substantial amount of credit risk of banks tends to be concentrated among few firms, consistent with the notion of granularity developed by Gabaix (2011). Moreover, durable lending relationships may produce valuable informational advantages for banks, as in Bolton et al. (2016). We want to make sure that our main results on lending exposures, as captured by the *Share* variable, are robust to controlling for these alternative lending relationship considerations. To capture the granularity of the lending relationship between the bank and the firm, we use the ratio between the total amount of loans of the firm with the bank over the *total assets of the bank* as of 2009:12, and to capture the duration of the lending relationship between the bank and the firm, we use the log of 1 plus the number of months since the first lending relationship with the bank since 1999:12. The results are presented in Table 4. We find that our main results on the *Share* variable are robust to controlling for the concentration of the bank's credit risk in the firm (Panel A) and for the duration of lending relationships between the bank and the firm (Panel B). Moreover, we find that for important firms for the bank (the granularity measure), interestingly, the bank lends equally with PGL as compared to private loans.

Taken together, the results indicate that pre-existing credit exposures, as measured by the S*hare* variable, matter for obtaining PGL and it does so much more than for non-guaranteed loans. Moreover, the effect of loan relationships as measured by the *Share* variable is more pronounced for risky and more affected firms, and these risky lending is especially stronger for weaker/riskier banks, as captured by banks' capital and NPL ratios. Moreover, the opposite happens in private loans. In sum, the evidence suggests risk-shifting (of riskier credit) to taxpayers by riskier banks, i.e. by banks with ex-ante weaker bank balance sheets.

In Table 5, we estimate the implications of the public guarantee scheme for the loan amount (columns (1) to (3)) and the interest charged (columns (4) to (6)) of granted loans. The analysis is conducted at the firm-type of loan-bank level, which allows us to include firm*bank fixed effects and effectively compare different type of loans granted to the same firm. We find that PGL are on average larger in magnitude, 46% higher than non-PGL, and that the *Share* variable has a positive effect on the loan amount (column (1)). We also observe that the amount granted for PGL is even higher among firms with higher ex-ante credit dependency with the bank (i.e., with higher *Share*). In fact, the granted PGL amount for a given firm increases by 57% if the firm's credit share with the bank is high (interquartile range increase).

We also estimate the effect on the loan interest rate. We find that PGL also tend to have lower interest rates than non-PGL (2.3 percentage points on average). We also find that a higher *Share* reduces the loan interest rate and, interestingly, that the effect on *PGL* is amplified for higher levels of *Share*. Interest rates of PGL further decreases to 2.9 percentage points if the firm's credit share with the bank is high (an interquartile range increase). Therefore, results on higher volume and lower rates from Table 5 suggest a credit supply mechanism at play.

7.2 Substitution of private credit, early repayments and delinquencies

Next, we investigate whether the granting of PGL results in a substitution of private credit (non-PGL) by public credit (PGL), and in a change in overall credit exposures between bank-firm pairs.

We first find that firm-bank pairs with PGL tend to reduce their share of non-PGL in the firm. This suggests that the public guarantee scheme contributed to a substitution of private credit (non-PGL) for publicly guaranteed credit (PGL). The estimated effect is economically meaningful. Based on the estimates in column (5), firm-bank pairs with PGL experience a decrease of 7.8 percentage points in the share of nonguaranteed loans over the analyzed period. Results are qualitatively unaltered when replacing the PGL dummy with PGL amount/Assets (column (6)) and when replacing *ΔShare* with *ΔCredi*t, computed based on non-guaranteed loans only (column (7)). Specifically, in column (7) we find that the total volume of non-public guaranteed loans declines by 15.4 percentage points for banks that grant PGL to the firm.

Next, we analyze the impact of PGL on the total credit exposures between bank and firm pairs. In contrast to the effects on non-PGL, we find that firm-bank pairs with PGL tend to

strengthen their lending relationships, in the sense that they increase the share of total loans between the firm and the bank. This suggests that the public guarantee scheme contributes to an increase in the concentration of credit among pre-existing lending relationships (but based on PGL, as non-PGL are reduced) and further strengthens the idea that the public guarantee scheme resulted in a credit substitution between public and private credit, in line with hypothesis 4. We undergo this analysis by changing the *ΔShare* variable based on nonguaranteed loans with a variable that measures the change in the bank's share in the firm's total loans over the same period. Otherwise, the specifications are the same as before. The results are presented in Panel B of Table 6. The economic effects of the results on total loans are substantial. Firm-bank pairs with PGL experience an increase of 16.9 percentage points in the loan shares over the analyzed period (column (5) of Panel B) and overall credit for these firm-bank pairs increases by 116.8 percentage points (column (7) of Panel B).

In Table 7, we investigate whether there are heterogeneous effects along bank and firm characteristics of the substitution effects identified in Table 6. A key driver of substitution could be the residual loan maturity. To the extent that the public guarantee scheme protects against rollover risk, banks may have an incentive to replace non-guaranteed loans with guaranteed loans as they expire. This would imply that the substitution effect would be stronger for bank-firm pairs with a shorter residual maturity of outstanding loans. Moreover, to the extent that risk-shifting is at place, this effect may be stronger for riskier firms and banks. In line with these hypothesis, we find in Panel A of Table 7 that granting a PGL is associated with a reduction in the share of non-PGL, and that this substitution effect is more pronounced for firm-bank pairs with a shorter residual maturity of outstanding loans (column (1)). Moreover, this impact of maturity on the substitution channel is more pronounced for riskier firms (column (2)) and even more when the firms are more negatively affected by the crisis (column (5)), and this risk shifting effect is more pronounced for banks with less capital (column (6)).[20] This evidence suggests that risk shifting to taxpayers of risky credit by weaker banks is a key driver of the substitution channel. Differently, in Panel B of Table 7 where we assess the impact on total loans, we do not find significant effects on riskier firms (riskier scoring in affected sectors) and by riskier banks (lower capital or higher NPLs). Specifically, we find that banks that banks grant a PGL increase their overall share of loans in the firm, and that this effect is

[20] Effects are similar for Banks with higher NPLs but effects are not significant at conventional levels.

stronger if the residual maturity of outstanding loans is shorter, but not differential effects on riskier firms and banks..

In terms of the economic impact, for firms with lower residual maturity in December 2019 (a decrease in the interquartile range), the share of total loans increases by 22.7 percentage points and by 26 percentage points if, additionally, the firm is risky (interquartile increase) or belongs to the more negatively affected sectors. Analyzing the share in terms of non-PGL, firms with debt with shorter residual maturity in lending to riskier firms in more negatively affected sectors and working with less capitalized banks (interquartile decrease) decrease non-PGL share by 15.9 percentage points.

Panel A of Figure 2 presents time-varying coefficients of the effect of public guaranteed loans on the firm's non-public guaranteed loan share in a bank, derived from the estimation of the regression specification in column (5) of Panel A of Table 6 using different end points of the sample period. Panel B of Figure 2 presents similar time-varying coefficients but estimated for total loans instead of non-PGL based on the specification in column (5) of Panel B in Table 6. In both cases, confidence bands are presented based on 95% confidence levels. In terms of interpretation, it is important to point out that the majority of PGL were granted in the first quarter following the inception of the guarantee scheme (i.e., between April and June 2020, 70% of all PGL were granted, and only 0.5% of all PG loans were granted in March). Figure 2 shows that there was no change in loan share for non-PGL (Panel A) and for total loans (Panel B) in the first month (March 2020) of the guarantee scheme. Thus, the behavior at the time of the inception of the guarantee scheme was similar between bank-firm pairs with PGL and bank-firm pairs without PGL. It is only in the subsequent two months, until June 2020, when the majority of PGL were granted, that a substantial difference emerges between PGL and non-PGL. Specifically, there is a change in loan share for non-PGL in this subsequent periods (Panel A), while the change in loan share of total loans increases sharply from zero.

Next, we further analyze the mechanisms by which the substitution of loans take place, and in particular we test whether the proceeds from PGL are used for the early repayment of outstanding loans and whether banks that provide PGL have less delinquencies in their private loans to firms.

We find that pre-existing loans from banks that grant a PGL are more prone to be early repaid. This suggests that the public guarantee scheme is used by banks to facilitate the

recovery of their pre-existing (private) loans (non-PGL), in line with hypothesis 4. These findings should be seen against the background that under the public guarantee scheme loan restructurings were not permitted. The effect is economically relevant as it increases the early repayment amount (over firm total assets) by 26.4% in the following six months since the PGL is granted.

Appendix Table A5 shows that results are robust when the early repayment of loans from a bank that grants PGL are compared to early repayment of loans from banks that granted non-PGL, as opposed to all outstanding loans. We make this change to address the concern that the results may simply be capturing a new bank loan effect whereby firms early repay more to banks after the bank grants them new loans, independently of the loan being PGL or not. In this case, we find that the repayment channel kicks after 4 months.

A key driver of early repayment could be the residual maturity of the loan. Maturing loans face higher rollover risk and are therefore more likely to be the target of prepayment by banks. In Panel B of Table 8, we therefore consider heterogeneous effects of early repayment, focusing on loan maturity as a key driver of early repayment. As dependent variable, we use the cumulative early repayment amount computed over the first 6 months (i.e., the same variable as used in column (6) of Panel A). Consistent with our hypothesis, we find that early repayment is especially relevant when the outstanding loans have shorter (residual) maturity, and that this effect is stronger for banks with a higher share, for riskier firms, and for less capitalized banks. These results indicate that existing bank lending relationships tend to promote the early repayment of loans with higher rollover risk and do so in a way that is in line with risk shifting to taxpayers of risky credit (that granted to riskier firms) by riskier banks. From an economic point of view, the effect of PGL on the early repayment increases to 51.5% for firms with shorter residual maturity, to 76% when, in addition, the share between the banks and the firm is high, to 108.9% when the firm is riskier and to 194.9% when the bank is lowly capitalized.

The results on early repayment are indicative of PGL affecting the repayment behavior of firms. We now turn in Table 9 to analyze if PGL also affect another relevant aspect of loan repayment: loan delinquencies. We find that banks that grant PGL are less probable to get delinquent loans, after accounting for other channels through the inclusion of firm and bank fixed effects (column (1)), in line with hypothesis 5. This effect is particularly pronounced for firm-bank pairs with

a higher *Share* (column (2)), especially for risky firms and/or firms in affected sectors. The effects are economically meaningful. The presence of PGL reduces the probability of delinquent loans by 1.3 percentage points, which is a large effect given that firms with delinquent loans on average represent only 2.1% of the sample.[21] Therefore, if a firm has a PGL with a bank the likelihood to having delinquent loans decreases by 63.1%. Moreover, this decrease reaches 72.6% when the share between the firm and the bank is high (interquartile range increase), to 90.4% for riskier firms (interquartile range increase) or to 95.3% when the firm belong to a pandemic-affected sector, and, if, in addition, the bank is lowly capitalized the decrease is 143.6%.

8. Conclusions

The COVID-19 pandemic prompted large-scale government interventions to keep firms afloat, including pay protection programs for employees and loan guarantee schemes. Crucially, some COVID-19 related policies were implemented through third parties, notably publicly guaranteed loans (PGL), as PGL granting decisions were delegated to privately-owned banks. Hence, there is a possible divergence between bank private incentives (agent) and social incentives (principal), thereby affecting the effectiveness of the policy action. In this paper, we analyze the effects of PGL on the allocation and performance of bank credit focusing on the role of private bank incentives when credit decisions on partially PGL are delegated to banks.

To guide the empirical analysis, we build a stylized model in which banks' private incentives shape the granting of guaranteed loans. A key testable prediction generated by the model is that pre-existing credit exposure is a key determinant of PGL granting decisions. Moreover, the model predicts that this effect will depend on firm and bank characteristics, including firm and bank risk. For empirical identification, we exploit the COVID-19 crisis and the Spanish credit register with unique information on COVID PGL.

We find that during the COVID crisis: First, ex-ante riskier firms and riskier banks participate more on PGL, while the opposite happens on non-PGL (private credit). Second, firms are more likely to obtain a PGL from banks to which they have larger pre-COVID credit exposures, measured as the share of the firm's total credit outstanding with the bank before the

[21] As column (8) shows, results are robust to restricting the sample to firm-bank pairs that at the end of the period have non-PGL (we lose 36% of the sample), suggesting that the effect is not driven by the mechanical effect of the substitution of PGL for non-PGL.

shock. This effect is more pronounced for ex-ante risky firms and for firms in more pandemic-affected sectors, and this riskier lending is especially stronger by ex-ante riskier banks, with lower capital and higher nonperforming loans. The latter results are the opposite for non-PGL. Also, for a given firm, PGL loans have larger volumes and are granted at lower loan interest rates than non-PGL loans, especially the larger the pre-COVID credit share of the firm with the bank is. These results suggest a credit supply mechanism at play. Third, we show that the guarantee scheme results in credit substitution at the firm-bank level. For firms that obtain PGL from a bank, the share and amount of total credit of such bank increases, while the share and amount of non-PGL (private) credit for such bank in the firm declines, in part due to early prepayment and less ex-post loan delinquencies of outstanding private credit. These effects are stronger for ex-ante riskier firms and especially in conjunction by riskier banks.

Overall, our results show that the allocation of government guaranteed credit is shaped by banks' private incentives —notably pre-existing bank-firm credit exposures— resulting on risk shifting of credit to riskier firms by riskier banks to taxpayers. While such risk shifting may be individually optimal from the perspective of the bank and its main borrowers, it may be socially suboptimal. We leave a full-fledged welfare analysis for future research.

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TABLE 1

SUMMARY STATISTICS

This table reports units, means, standard deviations and first/second/third quartiles of the variables used in our analysis. In Panel A we show the descriptive statistics at firm-bank level of the study of the extensive margin (receiving a public guaranteed loan), and of the intensive margin at firm-bank-type of loan (public guaranteed or not) level (credit amount, interest rate and maturity) in Spain between 2020:03 to 2020:12. In Panel B we report the statistics at firm-bank level of the study of credit substitution between public and non-public guaranteed loans, of the analysis at firm-bank-type of loan level of early repayment of pre-existing loans after the public guarantee loan was granted, and of the study at firm-bank level of the future loan performance of firms in Spain between 2020:03 to 2021:06. All firm and bank characteristics are calculated as of December 2019. For a definition of the variables see the Appendix.

PANEL A. Loan granting decision and loan terms of granted loans

		Mean	S.D.	P25	Median	P75
Loan Granting Decision						
Public Guaranteed Loan (PGL)	0/1	0.378	0.485	0.000	0.000	1.000
Non-PGL	0/1	0.287	0.453	0.000	0.000	1.000
Loan Terms						
Public Guaranteed Loans (PGL)	0/1	0.500	0.500	0.000	0.500	1.000
Committed amount	€	129,649	162,690	20,000	59,994	163,897
Interest rate	%	3.334	2.966	1.530	2.427	3.665
Firm Characteristics(i)						
SME	0/1	0.954	0.208	1.000	1.000	1.000
Risk	Standardized	0.000	1.000	-0.729	-0.105	0.614
Liquidity	0.0x%	0.112	0.154	0.012	0.050	0.149
Affected Sector	0/1	0.623	0.485	0.000	1.000	1.000
Firm-Bank Characteristics(ij)						
Share	0.0x%	0.266	0.312	0.003	0.136	0.429
Ln(Average residual maturity)	Log(months)	1.859	1.612	0.000	1.946	3.258
Granularity	%	0.001	0.034	0.000	0.000	0.000
Ln(1+length of the relationship)	Log(months)	3.969	2.122	3.091	4.159	5.198
Bank Characteristics(j)						
Ln(Assets)	Log(1000€)	18.212	1.894	17.405	18.991	19.810
Capital ratio	0.0x%	0.093	0.040	0.064	0.080	0.118
ROA	0.0x%	0.009	0.012	0.005	0.006	0.007
Liquidity ratio	0.0x%	0.074	0.039	0.069	0.074	0.095
NPL ratio	0.0x%	0.046	0.018	0.030	0.050	0.056

PANEL B. Substitution, Early Repayment and Delinquency

		Mean	S.D.	P25	Median	P75
Substitution						
ΔShare non-PGL$_{2021:06\text{-}2019:12}$	%	-4.163	23.971	-12.091	-1.956	3.621
ΔShare Total loans$_{2021:06\text{-}2019:12}$	%	-3.42	21.37	-9.88	-1.72	3.51
ΔCredit non-PGL$_{2021:06\text{-}2019:12}$	%	-89.732	95.755	-200.000	-81.530	-15.916
ΔCredit Total loans$_{2021:06\text{-}2019:12}$	%	-36.127	108.986	-129.901	-12.065	37.068
Delinquent	0/1	0.021	0.142	0.000	0.000	0.000
PGL	0/1	0.397	0.489	0.000	0.000	1.000
PGL amount/total assets	0.0x%	0.069	0.144	0.000	0.000	0.077
Early repayment						
Cumulative early repayment 6 months	0.0x%	0.004	0.036	0.000	0.000	0.000
PGL	0/1	0.054	0.227	0.000	0.000	0.000
Firm Characteristics(i)						
Risk	Standardized	0.000	1.000	-0.728	-0.104	0.615
Affected Sector	0/1	0.621	0.485	0.000	1.000	1.000
Firm-Bank Characteristics(ij)						
Share	0.0x%	0.291	0.276	0.065	0.197	0.455
Ln(Average residual maturity)	Log(months)	2.270	1.495	1.099	2.398	3.478
Bank Characteristics(j)						
Capital ratio	0.0x%	0.086	0.033	0.063	0.080	0.093
NPL ratio	0.0x%	0.046	0.018	0.037	0.047	0.056

TABLE 2

LOAN GRANTING DECISION AT FIRM-BANK LEVEL

This table reports regressions results of a linear probability model at firm-bank level of the probability of a firm to get a public guarantee loan or a non-stated-backed one, between 2020:03 to 2020:12. Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Dependent variable:		Public Guarantee Loan (0/1)					Non-Public Guarantee Loan (0/1)				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Firm Characteristics(i)	SME	0.119***	0.112***	0.106***	0.108***		-0.151***	-0.143***	-0.138***	-0.129***	
		(0.020)	(0.018)	(0.016)	(0.016)		(0.019)	(0.018)	(0.018)	(0.019)	
	Risk	0.026***	0.029***	0.029***	0.029***		-0.014**	-0.013**	-0.013*	-0.014**	
		(0.006)	(0.006)	(0.007)	(0.007)		(0.006)	(0.006)	(0.006)	(0.007)	
	Liquidity	-0.242***	-0.253***	-0.262***	-0.244***		0.006	0.020	0.022	0.036	
		(0.043)	(0.042)	(0.044)	(0.045)		(0.041)	(0.040)	(0.041)	(0.040)	
	Growth opportunities	0.038***	0.039***	0.041***	0.039***		-0.022***	-0.020***	-0.022***	-0.021***	
		(0.005)	(0.005)	(0.005)	(0.006)		(0.004)	(0.004)	(0.005)	(0.005)	
	Affected Sector	0.037***					-0.012***				
		(0.004)					(0.004)				
Firm-Bank Characteristics(ij)	Share	0.116***	0.112***	0.142***	0.129***	0.216***	0.035**	0.041***	0.043**	0.033**	0.027*
		(0.020)	(0.020)	(0.021)	(0.022)	(0.023)	(0.015)	(0.015)	(0.017)	(0.016)	(0.015)
	Ln(Average residual maturity)	0.017***	0.018***	0.013**	0.015***	-0.005	-0.055***	-0.055***	-0.056***	-0.041***	-0.039***
		(0.006)	(0.006)	(0.005)	(0.006)	(0.004)	(0.010)	(0.010)	(0.010)	(0.007)	(0.006)
Bank Characteristics(j)	Ln(Assets)	0.056***	0.056***	0.058***			0.006	0.007	0.006		
		(0.005)	(0.005)	(0.005)			(0.010)	(0.010)	(0.010)		
	Capital ratio	-0.641*	-0.639*	-0.604*			1.966*	1.980*	1.995*		
		(0.367)	(0.363)	(0.352)			(1.082)	(1.086)	(1.057)		
	ROA	-1.998**	-2.074**	-2.114**			5.097	5.185	5.190		
		(0.908)	(0.917)	(0.904)			(3.547)	(3.541)	(3.478)		
	Liquidity ratio	0.349	0.352	0.344			0.976***	0.978***	0.988***		
		(0.258)	(0.258)	(0.250)			(0.360)	(0.361)	(0.359)		
	NPL ratio	1.665**	1.636**	1.509**			-1.507	-1.519	-1.492		
		(0.640)	(0.643)	(0.623)			(1.526)	(1.531)	(1.495)		
	Zip code Fixed Effects	Yes	Yes	-	-	-	Yes	Yes	-	-	-
	Industry Fixed Effects (NACE 2 digits)	No	Yes	-	-	-	No	Yes	-	-	-
	Industry*Zip Code Fixed Effects	No	No	Yes	Yes	-	No	No	Yes	Yes	-
	Bank Fixed Effects	No	No	No	Yes	Yes	No	No	No	Yes	Yes
	Firm Fixed Effects	No	No	No	No	Yes	No	No	No	No	Yes
	Observations	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204
	R2	0.154	0.161	0.260	0.279	0.475	0.122	0.126	0.214	0.266	0.437

TABLE 3

LOAN GRANTING DECISION AT FIRM-BANK LEVEL: HETEROGENEITY

This table reports regressions results of a linear probability model at firm-bank level of the probability of a firm to get a public guarantee loan or a non-stated-backed one between 2020:03 to 2020:12. Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Dependent variable:	Public Guarantee Loan (0/1)					Non-Public Guarantee Loan (0/1)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Share	0.221***	0.216***	0.222***	0.223***	0.200***	0.027*	0.027*	0.027*	0.028*	0.028*
	(0.024)	(0.023)	(0.023)	(0.024)	(0.022)	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)
Share*Risk	0.050***		0.054***	0.055***	0.044***	0.000		-0.001	-0.000	0.000
	(0.004)		(0.004)	(0.004)	(0.004)	(0.005)		(0.005)	(0.005)	(0.003)
Share*Affected sectors		0.022***	0.041***	0.040***	0.031***		-0.011***	-0.011**	-0.011**	-0.011**
		(0.006)	(0.006)	(0.006)	(0.006)		(0.004)	(0.004)	(0.004)	(0.004)
Share*Risk*Affected sectors				0.015***	0.013***				0.011***	0.012**
				(0.004)	(0.004)				(0.004)	(0.005)
Share*Risk*Affected sectors* Bank Capital ratio					-0.434**					0.395**
					(0.177)					(0.190)
Share*Risk*Affected sectors*Bank NPL ratio					0.719**					-0.697*
					(0.303)					(0.360)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204
R2	0.476	0.475	0.476	0.476	0.478	0.437	0.437	0.437	0.437	0.441

TABLE 4

LOAN GRANTING DECISION AT FIRM-BANK LEVEL: OTHER RELATIONSHIP VARIABLES

This table reports regressions results of a linear probability model at firm-bank level of the probability of a firm to get a public guarantee loan (columns (1) to (10)) or a non-stated-backed one (columns (11) and (12)) between 2020:03 to 2020:12. Granularity has been standardized to have 0 mean and the same variance that the share variable to make their effects comparable. Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Panel A. Granularity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable:						Public Guarantee Loan (0/1)					Non-PGL (0/1)	
Share						0.216***	0.221***	0.216***	0.222***	0.223***		0.027*
						(0.023)	(0.024)	(0.023)	(0.024)	(0.024)		(0.015)
Share*Risk							0.050***		0.054***	0.055***		
							(0.004)		(0.004)	(0.004)		
Share*Affected sectors								0.022***	0.041***	0.040***		
								(0.006)	(0.006)	(0.006)		
Share*Risk*Affected sectors										0.015***		
										(0.004)		
Granularity	0.010***	0.010***	0.011***	0.012***	0.012***	0.007***	0.007***	0.007***	0.007***	0.007***	0.008**	0.008**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Granularity*Risk		-0.001		-0.001	-0.001		-0.003**		-0.004**	-0.004**		
		(0.002)		(0.002)	(0.002)		(0.002)		(0.002)	(0.002)		
Granularity*Affected sectors			0.006	0.005	0.006*			0.002	0.001	0.001		
			(0.003)	(0.003)	(0.003)			(0.002)	(0.003)	(0.003)		
Granularity*Risk*Affected sectors					-0.005					-0.004		
					(0.004)					(0.003)		
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718204	718204
R2	0.466	0.466	0.466	0.466	0.466	0.475	0.476	0.475	0.476	0.476	0.437	0.437

Panel B. Length of the relationship

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable:						Public Guarantee Loan (0/1)					Non-PGL (0/1)	
Share						0.228***	0.233***	0.228***	0.233***	0.235***		0.036**
						(0.022)	(0.023)	(0.022)	(0.023)	(0.023)		(0.016)
Share*Risk							0.050***		0.053***	0.054***		
							(0.004)		(0.004)	(0.004)		
Share*Affected sectors								0.024***	0.043***	0.042***		
								(0.005)	(0.006)	(0.006)		
Share*Risk*Affected sectors										0.013***		
										(0.004)		
Ln(1+lenght of the relationship)	-0.031***	-0.031***	-0.031***	-0.031***	-0.031***	-0.033***	-0.033***	-0.033***	-0.033***	-0.033***	-0.025***	-0.025***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ln(1+lenght)*Risk		0.001		0.001	0.001		0.000		0.000	0.000		
		(0.001)		(0.001)	(0.001)		(0.001)		(0.001)	(0.001)		
Ln(1+length)*Affected sectors			-0.001**	-0.001*	-0.001			-0.002***	-0.002***	-0.002***		
			(0.001)	(0.001)	(0.001)			(0.001)	(0.001)	(0.001)		
Ln(1+length)*Risk*Affected sectors					-0.000					-0.000		
					(0.001)					(0.001)		
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718,204	718204	718204
R2	0.475	0.475	0.475	0.475	0.475	0.485	0.486	0.485	0.486	0.486	0.444	0.444

TABLE 5

LOAN TERMS OF GRANTED LOANS AT FIRM-BANK-TYPE OF LOAN LEVEL

This table reports regressions results of a Poisson model (columns (1), (2) and (3)), or a linear model (columns (4), (5) and (6)) at firm-bank-type of loan (public guarantee loan or not) level of the new commitment amount granted between 2020:03 to 2020:12. PGL is a dummy equal to 1 if the firm received a public guarantee loan and 0 otherwise. Share is the share of a firm's total credit obtained from the bank, computed at the firm-bank level using committed loan amounts as of 2019:12. Loan amount captures the total committed amount of new loans. Interest rate is the weighted average (using the loan amount) interest rate of new loans granted by type of loan. Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	Loan amount			Interest rate		
PGL	0.426***	0.460***	0.476***	-2.201***	-2.306***	-2.299***
	(0.084)	(0.106)	(0.107)	(0.199)	(0.237)	(0.224)
Share	0.827***			-0.659***		
	(0.043)			(0.069)		
PGL*Share			0.189***			-0.946***
			(0.071)			(0.348)
Bank Fixed Effetcs	Yes	-	-	Yes	-	-
Firm Fixed Effetcs	Yes	-	-	Yes	-	-
Firm*Bank Fixed Effetcs	No	Yes	Yes	No	Yes	Yes
Observations	620,451	345,416	345,416	470,263	289,358	289,358
R2	0.720	0.785	0.785	0.546	0.695	0.697

TABLE 6

EFFECT OF GRANTING A PUBLIC GUARANTEE LOAN ON FIRM-BANK CREDIT RELATIONSHIPS

This table reports regressions results of a regression model estimated using OLS at the firm-bank level of the effect of public guaranteed loans on firm-bank relationships between December 2019 and June 2021. Panel A analyzes non-PGL where Panel B analyzes total credit. ΔShare is the change in the firm's share of non-public guaranteed loans (Panel A) or total loans (Panel B), based on loan amounts, over the period December 2019 to June 2021. ΔCredit the log change in non-public guaranteed loans (Panel A) or total loans (Panel B) between the firm and the bank, computed over the period December 2019 to June 2021. PGL is a dummy equal to 1 if the firm received a public guarantee loan from the bank over the period December 2019 to June 2021, and 0 otherwise. PGL amount/Assets is the ratio of the total amount of public guaranteed loans that the firm received from the bank over the period December 2019 to June 2021, divided by the firm's total assets at year-end 2019. Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Panel A. Non-public guarantee loans

Dependent variable:	Non-Public Guarantee Loans						
	ΔShare (non-PGL)$_{2021:06\text{-}2019:12}$						ΔCredit (non-PGL)$_{2021:06\text{-}2019:12}$
	(1)	(2)	(3)	(4)	(5)	(6) Intensity	(7)
PGL	-3.095***	-3.129***	-4.010***	-5.118***	-7.781***		-15.355***
	(0.850)	(0.837)	(0.763)	(0.411)	(0.340)		(2.454)
PGL amount/Assets						-28.505***	
						(2.843)	
Zip code Fixed Effects	Yes	Yes	-	-	-	-	-
Industry Fixed Effects (NACE 2 digits)	No	Yes	-	-	-	-	-
Industry*Zip Code Fixed Effects	No	No	Yes	Yes	-	-	-
Bank Fixed Effects	No	No	No	Yes	Yes	Yes	Yes
Firm Fixed Effects	No	No	No	No	Yes	Yes	Yes
Observations	597,686	597,686	597,686	597,686	597,686	597,686	597,686
R2	0.017	0.018	0.072	0.091	0.205	0.207	0.458

Panel B. Total loans

Dependent variable:	Total Loans						
	ΔShare (Total loans)$_{2021:06\text{-}2019:12}$						ΔCredit (Total l)$_{2021:06\text{-}2019:12}$
	(1)	(2)	(3)	(4)	(5)	(6) Intensity	(7)
PGL	13.565***	13.723***	14.786***	14.034***	16.894***		116.788***
	(1.242)	(1.229)	(1.264)	(1.338)	(1.522)		(3.930)
PGL amount/Assets						59.997***	
						(2.581)	
Zip code Fixed Effects	Yes	Yes	-	-	-	-	-
Industry Fixed Effects (NACE 2 digits)	No	Yes	-	-	-	-	-
Industry*Zip Code Fixed Effects	No	No	Yes	Yes	-	-	-
Bank Fixed Effects	No	No	No	Yes	Yes	Yes	Yes
Firm Fixed Effects	No	No	No	No	Yes	Yes	Yes
Observations	597,686	597,686	597,686	597,686	597,686	597,686	597,686
R2	0.104	0.105	0.161	0.176	0.299	0.305	0.640

TABLE 7

EFFECT OF GRANTING A PUBLIC GUARANTEE LOAN ON FIRM-BANK CREDIT RELATIONSHIPS: HETEROGENEITY

This table reports regressions results of a regression model estimated using OLS at the firm-bank level of the effect of public guaranteed loans on firm-bank relationships between December 2019 and June 2021. Panel A analyzes non-PGL where Panel B analyzes total credit. ΔShare is the change in the firm's share of non-public guaranteed loans (Panel A) or total loans (Panel B), based on loan amounts, over the period December 2019 to June 2021. Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Panel A. Non-public guarantee loans

Dependent variable: ΔShare (non-PGL)$_{2021:06\text{-}20129:12}$	(1)	(2)	(3)	(4)	(5)	(6)
PGL	-8.317***	-8.325***	-8.324***	-8.337***	-8.309***	-8.894***
	(0.322)	(0.323)	(0.322)	(0.323)	(0.320)	(0.331)
PGL*Ln(residual maturity)	3.167***	3.074***	3.174***	3.072***	3.088***	3.484***
	(0.210)	(0.208)	(0.210)	(0.208)	(0.205)	(0.213)
PGL*Ln(residual maturity)*Risk		0.187*		0.187*	0.195*	0.195*
		(0.107)		(0.110)	(0.111)	(0.107)
PGL*Ln(residual maturity)*Affected sectors			0.003	0.048	-0.036	0.048
			(0.149)	(0.155)	(0.165)	(0.155)
PGL*Ln(residual maturity)*Risk*Affected sectors					0.278*	0.278*
					(0.148)	(0.148)
PGL*Ln(residual maturity)*Risk*Affected sectors*Bank Capital ratio						-13.237**
						(6.252)
PGL*Ln(residual maturity)*Risk*Affected sectors*Bank NPL ratio						14.142
						(11.088)
Zip code Fixed Effects						
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	597,686	597,686	597,686	597,686	597,686	597,686
R2	0.210	0.211	0.210	0.211	0.211	0.211

Panel B. Total loans

Dependent variable: ΔShare (Total loans)$_{2021:06\text{-}20129:12}$	(1)	(2)	(3)	(4)	(5)	(6)
PGL	19.732***	19.898***	19.803***	20.776***	20.655***	20.277***
	(2.016)	(1.996)	(2.075)	(2.045)	(2.026)	(2.011)
PGL*Ln(residual maturity)	-1.240***	-1.280***	-1.416***	-1.636***	-1.616***	-1.616***
	(0.241)	(0.236)	(0.274)	(0.275)	(0.267)	(0.267)
PGL*Ln(residual maturity)*Risk		0.624***		0.670***	0.593***	0.631***
		(0.094)		(0.093)	(0.101)	(0.097)
PGL*Ln(residual maturity)*Affected sectors			0.308*	0.578***	0.566***	0.576***
			(0.165)	(0.158)	(0.159)	(0.158)
PGL*Ln(residual maturity)*Risk*Affected sectors					0.122	-0.880
					(0.118)	(1.742)
PGL*Ln(residual maturity)*Risk*Affected sectors*Bank Capital ratio						3.983
						(5.783)
PGL*Ln(residual maturity)*Risk*Affected sectors*Bank NPL ratio						13.249
						(9.244)
Zip code Fixed Effects						
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	597,686	597,686	597,686	597,686	597,686	597,686
R2	0.302	0.303	0.302	0.304	0.304	0.309

TABLE 8

EFFECT OF GRANTING A PUBLIC GUARANTEE LOAN ON FIRM'S EARLY REPAYMENTS

This table reports regressions results of a linear model estimated using OLS at firm-bank-month level of the effect of public guaranteed loans on early repayment between March 2020 and June 2021. The dependent variable is the cumulative early repayment amount divided by firm's total assets, computed based on all loans. PGL is a dummy equal to 1 if the firm received a public guarantee loan by a bank in month 0, and 0 otherwise. Share is the share of a firm's total credit obtained from the bank, computed at the firm-bank level using committed loan amounts as of 2019:12. We compare the early repayment amount of a firm to a bank in the subsequent months following the granting of a public guarantee loan with respect to the rest of the loans. Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

PANEL A. Direct effect

	Depnt. varib.: Cumulative early repayment amount/Total asset	(1)	(2)	(3)	(4)	(5)	(6)
		Compared to all outstanding loans					
		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
Loan characteristics (ij)	PGL	0.000	0.000	0.001*	0.001**	0.001**	0.001***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
	Bank*Year:month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
	Firm*Year:month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
	Observations	5,934,971	5,934,971	5,934,971	5,934,971	5,934,971	5,934,971
	R2	0.403	0.405	0.407	0.410	0.413	0.415

PANEL B. Heterogeneous effects

Depnt. varib.: 6 month cumulative early repayment amount/Total assets	(1)	(2)	(3)	(4)	(5)
ns					
PGL	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PGL*Ln(residual maturity)	-0.000***	-0.000***	-0.001***	-0.000***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PGL*Ln(residual maturity)*Share		-0.001***	-0.001***	-0.001**	-0.002***
		(0.000)	(0.000)	(0.000)	(0.001)
PGL*Ln(residual maturity)*Share*Risk			-0.001**	-0.001**	-0.002***
			(0.001)	(0.001)	(0.001)
PGL*Ln(residual maturity)*Share*Affected sectors			-0.001	-0.001	-0.001
			(0.001)	(0.001)	(0.001)
PGL*Ln(residual maturity)*Share*Risk*Affected sectors				0.000	0.000
				(0.001)	(0.001)
PGL*Ln(residual maturity)*Share*Risk*Affected sectors*Bank Capital ratio					0.087*
					(0.047)
PGL*Ln(residual maturity)*Share*Risk*Affected sectors*Bank NPL ratio					-0.076
					(0.065)
Bank*Year:month Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm*Year:month Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	478,160	478,160	478,160	478,160	478,160
R2	0.479	0.481	0.481	0.481	0.483

TABLE 9

EFFECT OF GRANTING A PUBLIC GUARANTEED LOANS ON FIRM'S DELINQUENCY

This table reports regressions results of linear probability model at firm-bank level of the effect of public guaranteed loans on firm delinquency between March 2020 and June 2021. In column (8), the sample is restricted to firms that as of June 2021 still have non-PGL with the bank. Delinquent is a dummy equal to 1 if the bank classified any loan of the firm as delinquent during the period analyzed, and 0 otherwise. PGL is a dummy equal to 1 if the firm received a public guarantee loan by a bank, and 0 otherwise. Share is the share of a firm's total credit obtained from the bank, computed at the firm-bank level using committed loan amounts as of 2019:12. Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Dependent variable: Delinquent	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PGL	-0.013***	-0.013***	-0.013***	-0.013***	-0.013***	-0.014***	-0.012***	-0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
PGL*Share		-0.005**	-0.007***	-0.005**	-0.008***	-0.009***	-0.009***	-0.008***
		(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
PGL*Share*Risk			-0.012***		-0.013***	-0.013***	-0.016***	-0.011***
			(0.003)		(0.003)	(0.003)	(0.003)	(0.003)
PGL*Share*Affected sectors				-0.007*	-0.012***	-0.012***	-0.007*	-0.008**
				(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
PGL*Share*Risk*Affected sectors						-0.010***	-0.012**	-0.017***
						(0.003)	(0.006)	(0.006)
PGL*Share*Risk*Affected sectors*Bank Capital ratio							0.177	0.095
							(0.198)	(0.266)
PGL*Share*Risk*Affected sectors*Bank NPL ratio							-0.282	-0.240
							(0.323)	(0.426)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	597,686	597,686	597,686	597,686	597,686	597,686	597,686	384,815
R2	0.500	0.500	0.501	0.500	0.501	0.501	0.501	0.597

FIGURE 1

FINANCIAL FLOWS OF SPANISH LOAN GUARANTEE SCHEME

This figure shows the financial obligations and flows of a loan disbursed on the Spanish loan guarantee scheme.

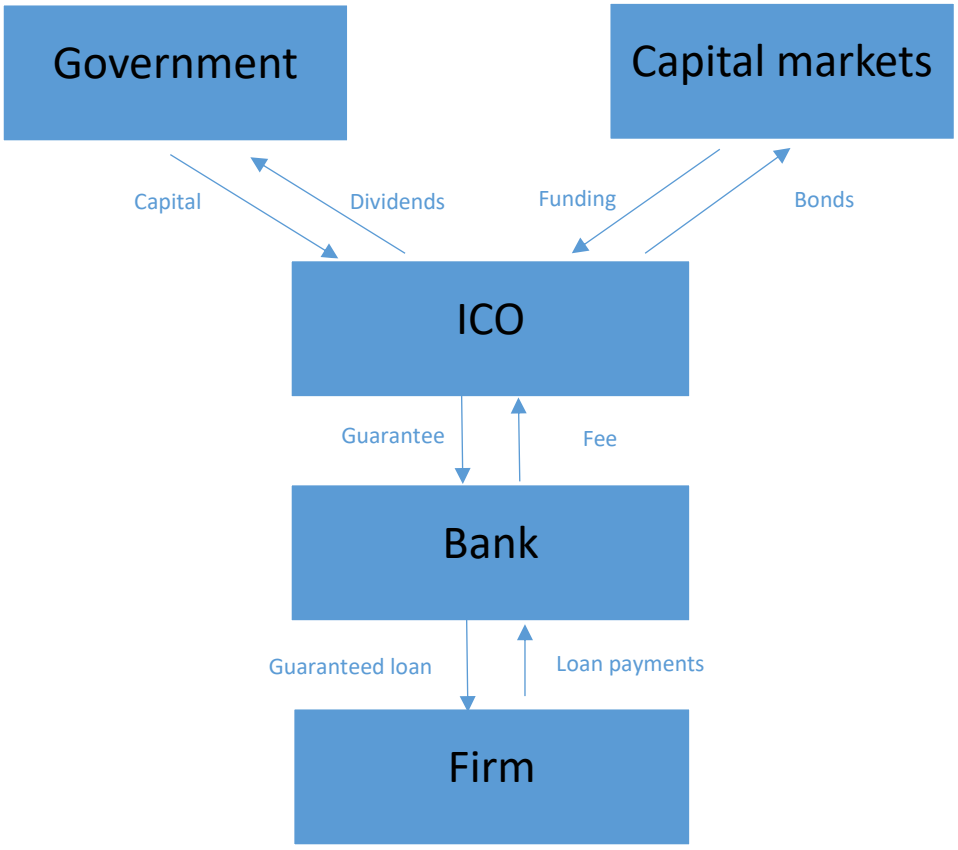
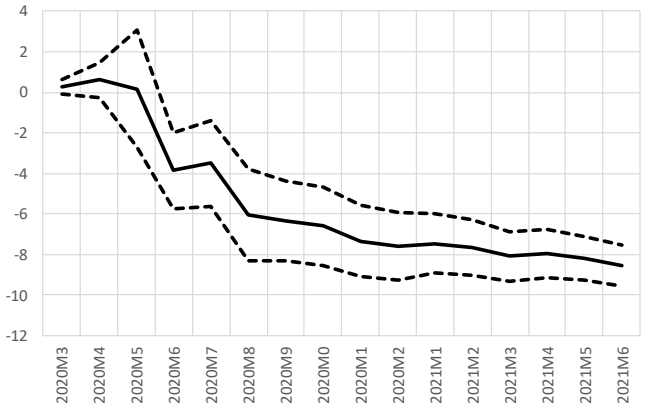


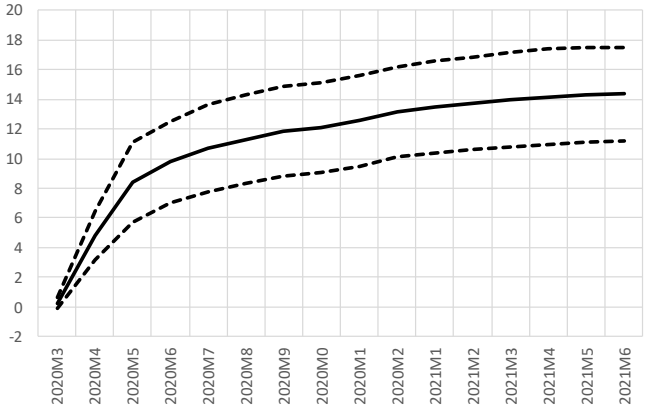
FIGURE 2
EFFECT OF GRANTING A PUBLIC GUARANTEE LOAN ON THE SHARE OF CREDIT OF THE FIRM WITH THE BANK

This figure shows the analogous estimated coefficient on PGL in Table 6 (column (5)) but referred to the first two months of 2020. Confidence bands at 95%.

Panel A. Change in the share of non-public guaranteed loans: Time varying coefficients



Panel B. Change in the share of total loan: Time varying coefficients



ONLINE APPENDIX A

TABLE A1

DEFINITION OF THE VARIABLES

Loan Granting Decision	
Public Guarantee Loan (PGL)	A dummy equal to 1 if the firm received a loan guaranteed by the estate and 0 otherwise.
Non-PGL	A dummy equal to 1 if the firm only received non-public guaranteed loans during the sample period.
Loan Terms	
Loan amount	Drawn plus undrawn amount of the loan.
Interest rate	Interest rate of the loan.
Firm Characteristics(i)	
SME	A dummy that takes 1 if the firm is a small or medium-sized enterprise (based on Commission Regulation (EU) No. 651/2014) and 0 otherwise.
Risk	A scoring variable which captures the credit risk of the firm (higher values implies higher risk).
Liquidity	The ratio between cash and other liquid assets of the firm over total assets.
Affected Sector	A dummy defined as sectors in which firm turnover on average decreased by more than 15% in 2020 with resepct 2019.
Firm-Bank Characteristics(ij)	
Share	The share of a firm's total credit obtained from the bank, computed at the firm-bank level using committed loan amounts as of 2019:12.
Ln(Average residual maturity)	The log of the average residual maturity of outstanding loans as of 2019:12.
Granularity	The ratio between the total amount of loans of the firm with the bank over the total assets of the bank as of 2009:12.
Ln(1+length of the relationship)	The log of 1 plus the number of months since the first relationship with the bank (since 1999:12).
Bank Characteristics(j)	
Ln(Assets)	The log of the bank's total assets (expressed in thousands of euros).
Capital ratio	The ratio of own funds over total assets of the bank.
ROA	The ratio of the bank's net profits to total assets. Liquidity ratio of the bank is the ratio of liquid assets over total assets.
Liquidity ratio	Bank's liquid assets over total assets.
NPL ratio	Non-performing loans (doubtful and 90 days overdue) over total loans of the bank.
Early repayment	
Cumulative early repayment 6 months	The cumulative early repayment during the first 6 months following the inception of the credit guarantee scheme, divided by the firm's total assets, and computed based on all loans.
Delinquency	
Delinquent	A dummy equal to 1 if the bank classified any loan of the firm as stage 3 during the period analyzed, and 0 otherwise.

TABLE A2

LOAN GRANTING DECISION AT FIRM-BANK LEVEL CONDITIONAL ON HAVING A LOAN GRANTED

This table reports regressions results of a linear probability model at firm-bank level of the probability of a firm to get a public guarantee loan between 2020:03 to 2020:12 given that a loan was granted between the firm and the bank. Panel A shows the direct effect and Panel B shows heterogeneous effects. Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Panel A. Direct effect

Dependent variable: Public Guarantee Loan (0/1)		(1)	(2)	(3)	(4)	(5)
Firm Characteristics(i)	SME	0.193***	0.185***	0.178***	0.177***	
		(0.023)	(0.022)	(0.021)	(0.023)	
	Risk	0.030***	0.031***	0.031***	0.032***	
		(0.007)	(0.008)	(0.009)	(0.009)	
	Liquidity	-0.181***	-0.197***	-0.212***	-0.195***	
		(0.055)	(0.053)	(0.054)	(0.054)	
	Affected Sector	0.024***				
		(0.005)				
Firm-Bank Characteristics(ij)	Share	0.048**	0.040*	0.068***	0.061**	0.127***
		(0.023)	(0.023)	(0.024)	(0.023)	(0.020)
	Ln(Average residual maturity)	0.043***	0.044***	0.039***	0.036***	0.019***
		(0.006)	(0.006)	(0.005)	(0.004)	(0.002)
Bank Characteristics(j)	Ln(Assets)	0.052***	0.051***	0.052***		
		(0.010)	(0.010)	(0.010)		
	Capital ratio	-1.710***	-1.720***	-1.653***		
		(0.528)	(0.533)	(0.519)		
	ROA	-3.535***	-3.657***	-3.733***		
		(1.258)	(1.278)	(1.260)		
	Liquidity ratio	-0.030	-0.038	-0.038		
		(0.409)	(0.408)	(0.399)		
	NPL ratio	1.796*	1.802*	1.725*		
		(1.007)	(1.015)	(1.012)		
	Zip code Fixed Effects	Yes	Yes	-	-	-
	Industry Fixed Effects (NACE 2 digits)	No	Yes	-	-	-
	Industry*Zip Code Fixed Effects	No	No	Yes	Yes	-
	Bank Fixed Effects	No	No	No	Yes	Yes
	Firm Fixed Effects	No	No	No	No	Yes
	Observations	413,104	413,104	413,104	413,104	413,104
	R2	0.212	0.218	0.343	0.375	0.565

Panel B. Heterogeneity

Dependent variable: Public Guarantee Loan (0/1)	(1)	(2)	(3)	(4)	(5)
Share	0.130***	0.127***	0.130***	0.129***	0.111***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.018)
Share*Risk	0.031***		0.033***	0.033***	0.031***
	(0.006)		(0.006)	(0.006)	(0.006)
Share*Affected sectors		0.009	0.020***	0.021***	0.035***
		(0.006)	(0.007)	(0.007)	(0.008)
Share*Risk*Affected sectors				-0.007	-0.003
				(0.005)	(0.008)
Share*Risk*Affected sectors*Bank Capital ratio					-0.713***
					(0.268)
Share*Risk*Affected sectors*Bank NPL ratio					1.098**
					(0.546)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	413,104	413,104	413,104	413,104	413,104
R2	0.565	0.565	0.565	0.565	0.566

TABLE A3

LOAN GRANTING DECISION AT FIRM-BANK LEVEL: ROBUSTNESS OF SHARE AND RISK VARIABLES

This table reports regressions results of a linear probability model at firm-bank level of the probability of a firm to get a public guarantee loan between 2020:03 to 2020:12. Panel A replaces the *Share* variable with a main bank dummy, which equals to 1 if the bank was the main lender of the firm in 2019:12 (in terms of credit) and 0 otherwise. Panel B stress the risk variable replacing it with Bad credit history, a dummy that takes 1 if the firm made some default before 2019:12 and 0 otherwise. Panel C replaces the risk variable by its highest decile (high risk). Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Panel A

Dependent variable: Public Guarantee Loan (0/1)	(1)	(2)	(3)	(4)	(5)	(6)
Main bank	0.118***	0.119***	0.118***	0.119***	0.119***	0.105***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Main bank*Risk		0.021***		0.022***	0.023***	0.018***
		(0.002)		(0.002)	(0.002)	(0.002)
Main bank*Affected sectors			0.011***	0.018***	0.018***	0.015***
			(0.003)	(0.003)	(0.003)	(0.003)
Main bank*Risk*Affected sectors					0.001	-0.000
					(0.002)	(0.003)
Main bank*Risk*Affected sectors*Bank Capital ratio						-0.300*
						(0.154)
Main bank*Risk*Affected sectors*Bank NPL ratio						0.495**
						(0.226)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	718,204	718,204	718,204	718,204	718,204	718,204
R2	0.474	0.474	0.474	0.474	0.474	0.475

Panel B

Dependent variable: Public Guarantee Loan (0/1)	(1)	(2)	(3)	(4)	(5)
Share	0.217***	0.216***	0.217***	0.217***	0.195***
	(0.023)	(0.023)	(0.023)	(0.023)	(0.021)
Share*Bad credit history	0.038***		0.039***	0.041***	0.056***
	(0.014)		(0.014)	(0.014)	(0.010)
Share*Affected sectors		0.022***	0.022***	0.022***	0.019***
		(0.006)	(0.006)	(0.006)	(0.005)
Share*Bad credit history*Affected sectors				0.037**	0.048***
				(0.016)	(0.014)
Share*Bad credit history*Affected sectors*Bank Capital ratio					-1.900***
					(0.637)
Share*Bad credit history*Affected sectors*Bank NPL ratio					1.558
					(1.270)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	718,204	718,204	718,204	718,204	718,204
R2	0.475	0.475	0.475	0.475	0.477

Panel C

Dependent variable: Public Guarantee Loan (0/1)	(1)	(2)	(3)	(4)	(5)
Share	0.217***	0.216***	0.217***	0.217***	0.195***
	(0.023)	(0.023)	(0.023)	(0.023)	(0.021)
Share*High risk	0.068***		0.073***	0.074***	0.066***
	(0.009)		(0.010)	(0.009)	(0.011)
Share*Affected sectors		0.022***	0.026***	0.026***	0.021***
		(0.006)	(0.006)	(0.006)	(0.005)
Share*High risk*Affected sectors				0.007	0.028*
				(0.014)	(0.014)
Share*High risk*Affected sectors*Capital ratio					-1.364**
					(0.576)
Share*High risk*Affected sectors*NPL ratio					2.241**
					(1.015)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	718,204	718,204	718,204	718,204	718,204
R2	0.475	0.475	0.475	0.475	0.477

TABLE A4

LOAN GRANTING DECISION AT FIRM-BANK LEVEL: FALSIFICATION TEST OF THE PERIOD

This table reports regressions results of a linear probability model at firm-bank level of the probability of a firm to get a loan. Different time periods are considered to address concerns that the effect of the *Share* variable analyzed in the period 2020:03-2020:12 is not affected by seasonal effects other than the COVID-19 pandemic. Post is a dummy that equals 1 for the months after the reference date until December of that year. Share is computed and the end of 2018. Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Dependent variable: Some loan received (0/1)		(1)	(2)	(3)	(4)	(5)
	Post≥	2019:02	2019:03	2019:04	2019:05	2019:06
Share*Post		-0.025	-0.022	-0.037	-0.018	-0.032
		(0.051)	(0.041)	(0.037)	(0.024)	(0.019)
Bank*Post Fixed Effects		Yes	Yes	Yes	Yes	Yes
Firm*Post Fixed Effects		Yes	Yes	Yes	Yes	Yes
Observations		972,897	1,037,420	1,073,568	1,114,195	1,133,724
R2		0.410	0.409	0.397	0.393	0.391

TABLE A5

SUBSTITUTION OF TOTAL LOANS: EARLY REPAYMENTS OF NEW LOANS ONLY

This table reports regressions results of a linear model estimated using OLS at firm-bank-month level of the effect of public guaranteed loans on early repayment between 2020:03 to 2021:06. The dependent variable is the cumulative early repayment amount divided by the firm's total assets, computed based on new loans only. PGL is a dummy equal to 1 if the firm received a public guarantee loan by a bank in month 0, and 0 otherwise. We compare the early repayment amount of a firm to a bank in the subsequent months to the granting of a public guarantee loan with respect to other (private) newly granted loans. Coefficients are listed in the first row, robust standard errors are reported in the row below which are corrected for multi-clustering at the firm and bank level, and the corresponding significance levels are in the adjacent column. "Yes" indicates that the set of characteristics or fixed effects is included, "No" that is not included and "-" that is comprised by the included set of fixed effects. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Depnt. varib.: Cumulative early repayment amount/Total assets	(1)	(2)	(3)	(4)	(5)	(6)
	Compared to other new loans					
	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
PGL	-0.000	0.000	0.000	0.000	0.000**	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bank*Year:month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm*Year:month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	478,160	478,160	478,160	478,160	478,160	478,160
R2	0.471	0.475	0.480	0.474	0.476	0.481

ONLINE APPENDIX B

STRATEGIC INTERACTION IN BANK LENDING DECISIONS

This section provides a micro foundation for the loan granting decision of banks when banks are strategic and take into account that the other bank can have incentives to grant the loan.

In order to determine which of the two banks grants the loan we assume that the decision to grant the loan is sequential. First one bank decides to grant the loan or not, and if such bank declines to grant the loan, then the other bank can decide to grant the loan or not. To simplify the analysis, we assume that decisions are final, and that which bank is the first one to take the decision is random. For simplicity we assume that banks have all the bargaining power and set the maximum loan rate possible, which in our case is the pledgeable income *Y*.

We solve the problem by backwards induction. The bank that decides in second place, which without loss of generality we denote by subindex 2, will grant the loan as long as

$$Dx_2 \geq \frac{(1-(1-p)g)L+F}{p} - Y = D\bar{x}$$

The bank that decides in first place takes into account that if it decides not to grant the loan, the second bank will grant the loan as long as $x_2 > \bar{x}$. When $x_2 > \bar{x}$ we can show that there are circumstances in which the first bank will not grant the loan, as it would profit from the second bank being the one that incurs in the costs of granting the loan. This happens when

$$-L + p(Dx_1 + Y) - F + (1-p)gL \ < \ p(Dx_1),$$

which can be rewritten as

$$-L + pY - F + (1-p)gL \ < \ 0,$$

This states that, in such circumstances, the PGL loan is valuable for the bank because it also allows the bank to obtain previous debt, and without such previous debt the PGL loan would not be granted. In such circumstances we know that the first bank will grant the loan as long as $x_2 < \bar{x}$ and $x_1 > \bar{x}$. If on the other hand

$$-L + pY - F + (1-p)gL \ > \ 0,$$

the first bank will grant the loan as long as $x_1 > \bar{x}$.