Online Appendix

Banks vs. Firms: Who Benefits from Credit Guarantees?

Alberto Martin, Sergio Mayordomo and Victoria Vanasco

This Online Appendix contains supplementary material for "Banks vs. Firms: Who Benefits from Credit Guarantees?". Section OA.1 analyzes guarantees during crises. Section OA.2 establishes the robustness of our modeling choices. Section OA.3 describes the Spanish ICO program.Section OA.4 collects additional figures and tables, and Section OA.5 the proofs of Propositions 5–7.

OA.1 Guarantees during crises

The analysis in the paper describes a stationary credit market. Many guarantee programs, however, are deployed in crises. We now feed a crisis through the model, allowing it to operate through the two margins emphasized by the literature: an increase in firms' funding needs and a decline in their productivity. Formally, a crisis is a pair $(\Delta k, F_\tau)$, where funding needs rise from k to $k + \Delta k$ and the productivity distribution deteriorates from F to F_τ, where $F_\tau(A) \geq F(A)$ for all A (first-order stochastic dominance). The COVID-19 pandemic embodies both margins. The surge in credit demand to bridge liquidity gaps is well documented; the ECB, for instance, noted in 2020: *"Demand from firms for bank loans has soared to record levels since March 2020 as firms have scrambled to bridge liquidity gaps originating*

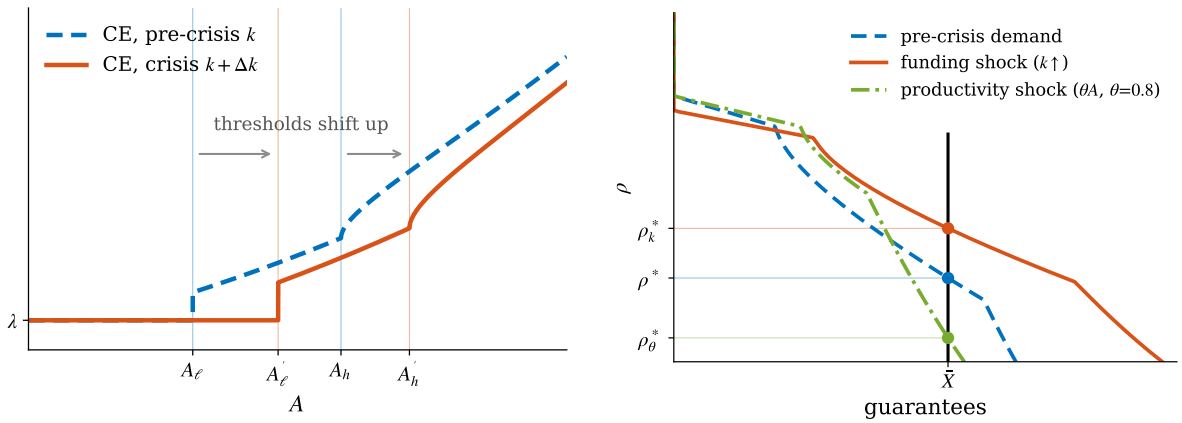
from the coronavirus (COVID-19) shock" (see Falagiarda et al. (2020)). At the same time, lockdowns durably reduced revenues in directly exposed sectors, such as hospitality, retail, and travel. We next describe how such shocks impact (i) the demand for guarantees, and (ii) the scarcity rents and capture they generate.

To analyze each shock, recall two aspects of the competitive equilibrium. First, continuation and captivity are governed by productivity thresholds that depend on funding needs k but not on the distribution F (Propositions 2 and 3). Second, guarantees are allocated to entrepreneurs that are risky enough to cover the shadow value of guarantees, ρ^g, yet productive enough to avoid liquidation with a guaranteed loan (Proposition 3). A shock can therefore move the thresholds for a given ρ^g — a partial-equilibrium effect — and, by moving entrepreneurs across them, change the shadow value ρ^g that clears the market (Equation 10) — a general-equilibrium effect.[1]

A funding crisis, $\Delta k > 0$. An increase in funding needs has both partial and general equilibrium effects. In partial equilibrium, it raises the thresholds: since $\bar{p}_A \cdot \bar{B}_A$ increases in A and does not depend on k, both $A^*_\ell(b)$ and $A^*_h(b)$ rise with k (Figure OA.1(a)). More entrepreneurs are liquidated and fewer are solvent. In general equilibrium, each guaranteed loan absorbs more guarantees and is worth more to its bank, but fewer entrepreneurs remain viable with a guaranteed loan. The effect on the demand for guarantees, and thus on ρ^g, is therefore ambiguous. When demand rises, as in Figure OA.1(b), the scarcity rent rises and pass-through falls for every recipient.

A deterioration of productivity, $A \mapsto \theta A$, with $\theta < 1$. This shock only has general equilibrium effects. No firm-level object is affected: the thresholds, contracts, and pass-through obtained by any given type are unchanged. The shock operates purely through general equilibrium: as the mass of entrepreneurs shifts to the left, more are liquidated and fewer are solvent, and the shadow value that clears the market changes. Its effect on the

[1] We assume throughout that, regardless of its origin, the crisis is never severe enough to eliminate solvent entrepreneurs (i.e., it is always the case that $A^*_h(b) \leq \theta \bar{A}$).



(a) Funding crisis: partial equilibrium

(b) Both crises: the guarantee market

Figure OA.1: **Crises and the guarantee market.** Panel (a): surplus per entrepreneur in the competitive equilibrium without guarantees, before (dashed) and after (solid) a funding shock $\Delta k = 0.03$. Panel (b): demand for guarantees before a crisis (dashed), after the funding shock (solid), and after a productivity shock $\theta = 0.8$ (dash-dot), and the supply $\bar{X}$. $b = 0.08$; other parameters as in Figure 1 of the main text.

demand for guarantees, and thus on ρ^g, is ambiguous: the sign is given by the net flow of entrepreneurs into the guaranteed set. Demand may fall, as in Figure OA.1(b), lowering ρ^g and the scarcity rents banks retain on guarantees to solvent borrowers. A large enough fall in productivity makes demand fall short of $\bar{X}$, so that $\rho^g = 0$.

Two implications follow. First, the two crises may load onto different distortions. A funding crisis can inflame both scarcity rents and capture. A deep productivity crisis extinguishes scarcity rents and leaves capture as the only distortion standing: guarantees keep flowing to captive borrowers on terms their legacy banks dictate. This distinction matters for the design of guarantee programs, as the two distortions call for different instruments. Second, the distortions we identify are not artifacts of crisis-scale programs: whether a downturn tightens or relaxes scarcity depends on where the margins of the guaranteed set lie in the distribution of productivity, so even a mild downturn may raise scarcity rents.

OA.2 Robustness of modeling choices

OA.2.1 Debt Renegotiation

In our baseline model of Section 2 we claimed that it was without loss of generality to suppose that all entrepreneurs, if financed, received a loan $b+k$ at an interest rate of R_A, which could be below one if the entrepreneur was captive.

We now show that our findings are isomorphic to those obtained in a setting in which the interest rate charged by banks is always equal to their marginal cost of funds, i.e., one, but banks are able to renegotiate downwards the debt of their borrowers when needed. In this scenario, captive borrowers re-negotiate their debt downwards to $\bar{p}_A \cdot \bar{B}_A - k < b$, and borrow $\bar{p}_A \cdot \bar{B}_A$ from their legacy banks to continue their projects.

Under this interpretation, Proposition 1 is then adjusted as follows.

Proposition OA.1. *For an entrepreneur with productivity A there are three possibilities in equilibrium:*

1. *$\bar{p}_A \cdot \bar{B}_A \geq b + k$: the entrepreneur is solvent, she borrows $b + k$ in the credit market, and continues her project, where*

$$B^*_{A,b} = \frac{b+k}{p_A(B^*_{A,b})} \tag{OA.1}$$

2. *$\bar{p}_A \cdot \bar{B}_A \in [\lambda + k, b + k)$: the entrepreneur is captive, she renegotiates her debt downwards to $\bar{p}_A \cdot \bar{B}_A - k$ and is able to borrow to continue her project, where*

$$B^*_{A,b} = w_A(\gamma) \cdot \bar{B}_A + (1 - w_A(\gamma)) \cdot \underline{B}_A,$$

   where $\gamma \in [0,1]$ is the bank's bargaining power and $w_A(0) = 0$, $w'_A > 0$, $w_A(1) = 1$.

3. *$\bar{p}_A \cdot \bar{B}_A < \lambda + k$: the entrepreneur is insolvent and her project is liquidated.*

The proof of the proposition is adjusted as follows.

Proof of Proposition OA.1. First, consider those entrepreneurs with $\overline{p}_A \cdot \overline{B}_A - k \geq b$. By construction, if these entrepreneurs invested k and continued their projects, they would have enough cash flows to repay $\frac{b+k}{p_A}$, which is the lowest repayment they could obtain from competitive banks, and where p_A solves

$$A - \frac{b+k}{p_A} = C'(p_A). \tag{OA.2}$$

It is immediate that these entrepreneurs generate enough surplus to avoid liquidation. Moreover, they will not accept a loan with a higher repayment, and their legacy bank will not be willing to renegotiate their debt downwards.

Second, consider those entrepreneurs with $\overline{p}_A \cdot \overline{B}_A - k < \lambda$. By construction, the bank will never be able to obtain more than λ from these entrepreneurs if they were to continue their projects. As liquidation ensures that the bank obtains λ (as we have supposed that $\lambda < b$), it is immediate that banks will liquidate the projects of these entrepreneurs.

Finally, consider those entrepreneurs with $\overline{p}_A \cdot \overline{B}_A - k \in [\lambda, b)$. As the legacy bank can extract more than λ from these entrepreneurs if their projects are continued, it is immediate that the bank strictly prefers to continue the project. These entrepreneurs, however, do not generate enough cash flows to repay $\frac{b+k}{p_A}$, and thus cannot access competitive markets for loans of size $b + k$. As a result, these entrepreneurs must renegotiate their existing debts. The proof is as the one presented in the Proof of Proposition 1. □

The rest of the propositions in the paper can be easily adjusted to a setting with the renegotiation interpretation, as was shown for Proposition 1. For renegotiation, what is important are the net transfers between the entrepreneur and her legacy bank at different points in time, and these are always: k from the bank to the entrepreneur at $t = 0$, and $B_{A,b}$ from the entrepreneur to the bank in the success scenario in $t = 1$. Whether the reduction

in repayments, $b + k - p_A \cdot B_{A,b}$, needed to continue the projects of captive entrepreneurs occurs through a downwards renegotiation of existing debt b or through a roll-over of b on concessional terms, $R_{A,b} < 1$, has no impact on outcomes.

OA.2.2 Long-term debt

In our baseline model of Section 2 we suppose that debt b is due at time $t = 0$, and that it must therefore be rolled-over for the entrepreneur to be able to continue her project. We now show that our results are robust to an environment with long-term debt by supposing that b is due at $t = 1$. In this scenario, the entrepreneur must only raise k at $t = 0$ to continue her projects. When debt is long-term, the issue of dilution of legacy debts at $t = 0$ may arise. To abstract from this, we assume throughout that the legacy bank has seniority at $t = 1$. As a result, new creditors cannot benefit from diluting legacy debt-holders.

Our main Proposition 1 is adjusted as follows

Proposition OA.2. *For entrepreneur $\{A, b\}$ there are three possibilities in equilibrium:*

1. *$\bar{p}_A \cdot \bar{B}_A \geq k + \bar{p}_A \cdot b$: the entrepreneur is solvent, she borrows k in the credit market at $R_A = 1$, and continues her project. Her repayment obligation at $t = 1$ is*

$$B^*_{A,b} = b + \frac{k}{p_A(B^*_{A,b})}. \tag{OA.3}$$

2. *$\bar{p}_A \cdot \bar{B}_A \in [\lambda + k, \bar{p}_A \cdot b + k)$: the entrepreneur is captive, she obtains loan k from her legacy bank on concessional terms, and is able to continue her project. Her repayment obligation at $t = 1$ is*

$$B^*_{A,b} = w_A(\gamma) \cdot \bar{B}_A + (1 - w_A(\gamma)) \cdot \underline{B}_A,$$

where $\gamma \in [0, 1]$ is the bank's bargaining power and $w_A(0) = 0$, $w'_A > 0$, $w_A(1) = 1$.

3. $\bar{p}_A \cdot \bar{B}_A < \lambda + k$: the entrepreneur cannot continue her project and it is liquidated.

The proof of Proposition OA.2 is isomorphic to the one of Proposition OA.1, where b is now replaced by $\bar{p}_A \cdot b$. The remaining proofs follow as well once this adjustment is made, highlighting that there are no conceptual differences between the model with short- vs long-term debt. In both scenarios the bank internalizes that its expected repayment may increase through debt/interest rate reductions, allowing captive entrepreneurs to continue their projects and exert higher effort.

OA.3 The Spanish ICO program

In 2020 the Spanish Government approved two public guarantee schemes for loans to firms and the self-employed. These schemes were aimed at facilitating access to finance for those firms that were most affected by the COVID-19 crisis.[2] Jointly considered, their size amounted to €140 billion, and they have been managed by the Official Credit Institute (ICO, by its Spanish abbreviation).

ICO guarantees cover up to 80% of the potential losses on bank finance extended to the self-employed and SMEs, and up to 70% or 60% of financing losses extended to non-SMEs depending on whether this financing is composed of new loans or rollovers. Banks paid ICO a fee on the guaranteed amount: 20 basis points a year for loans of up to €1.5 million and, for larger loans, between 20 and 120 basis points a year, depending on firm size and maturity. All loans granted to firms domiciled in Spain after March 17, 2020 were eligible for the program, excepting firms that were in a delinquency situation at CIRBE[3] as of December 31, 2019, firms that were subject to bankruptcy proceedings, and firms that were deemed to

[2]Royal Decree-Law (RDL) 8/2020 of 17 March 2020 approved a first public guarantee scheme for firms and the self-employed of up to €100 billion. The aim of the program was to cover the liquidity needs generated by COVID-related restrictions. RDL 25/2020 activated a second guarantee facility, of up to €40 billion, to meet funding needs linked to investment.

[3]A central risk database in Spain.

be in distress. In addition, it was required that neither the financing operation nor any other financing granted by the bank to that firm be in arrears. One key feature of the program is that banks were granted a share of total guarantees, based on their market share, for them to allocate across firms.

By all accounts, the ICO program played an important role in sustaining credit during the most acute period of the COVID crisis. By mid-2022, a total of €107 billion of guarantees had been granted, almost 85% of them during 2020. Figure OA.2 shows the evolution of new credit, drawn and undrawn, extended to non-financial corporations between January 2019 and February 2021. ICO loans made up a significant share of total credit during the COVID crisis, with 40% of the new credit granted between March and June of 2020 with ICO guarantees. By mid-2022, ICO guaranteed credit represented 18% of total outstanding credit to non-financial corporations.

The extent and conditions of access to ICO loans varied substantially across firms. Coverage of ICO loans was higher for firms facing greater financial difficulties, such as those in COVID affected sectors, SMEs, or high risk (see box 4.3 in Informe Anual Banco de España (2019)). Moreover, ICO and non-ICO loans were granted under very different terms. As Figure OA.3 shows, on average ICO loans had longer maturity, were larger, and had lower nominal interest rates –even when adjusting for loan characteristics,– than non-ICO loans. These rates exclude fees; Figure OA.4 reports average fees on loans with and without guarantees. However, not all firms benefited the same. As shown in Figure OA.5, the interest rate dispersion on ICO loans was substantially higher than that of non-ICO loans, even when controlling for loan characteristics, such as the type of loan, maturity, reference rate (fixed or floating), and the existence of other real or personal guarantees.

OA.4 Additional figures and tables

This section collects additional figures and tables. Figures OA.2–OA.5 describe the ICO program and the loans it guaranteed: the evolution of new credit, the maturity and interest rates of loans with and without guarantees, their fees, and their interest-rate dispersion.

Table OA.1 describes how new credit, with and without guarantees, was distributed across bank–firm relationships. Tables OA.2–OA.8 report robustness exercises for the results in Section 5. Table OA.2 concerns the allocation of guarantees across firms (Table 2). Because ICO loans have much longer maturities than other new loans, and part of new credit renews existing loans, the share of guaranteed credit depends on which loans enter its denominator; the results hold when we change the maturity cutoff, exclude renewed loans, or use all new credit. Table OA.3 concerns the allocation of guarantees to captive borrowers (Table 3). Captivity depends on how we measure vulnerability, and the comparison depends on how finely we control for default risk; the table varies both. Tables OA.4–OA.7 concern pass-through (Table 4), our central test. Table OA.4 replaces our measure of vulnerability with measures based only on default probabilities, and Table OA.7 varies the default-probability threshold that defines vulnerability. Table OA.5 keeps only loans with maturities above one year or excludes refinancing operations, so that guaranteed and non-guaranteed loans are more comparable. Table OA.6 varies the fixed effects. Of particular interest are firm and firm–time fixed effects, which compare loans to the same firm from different banks and therefore absorb unobserved firm risk that may affect pricing. Finally, Table OA.8 restricts the sample to guaranteed loans and compares their interest rate, size, and maturity across captive and non-captive borrowers.

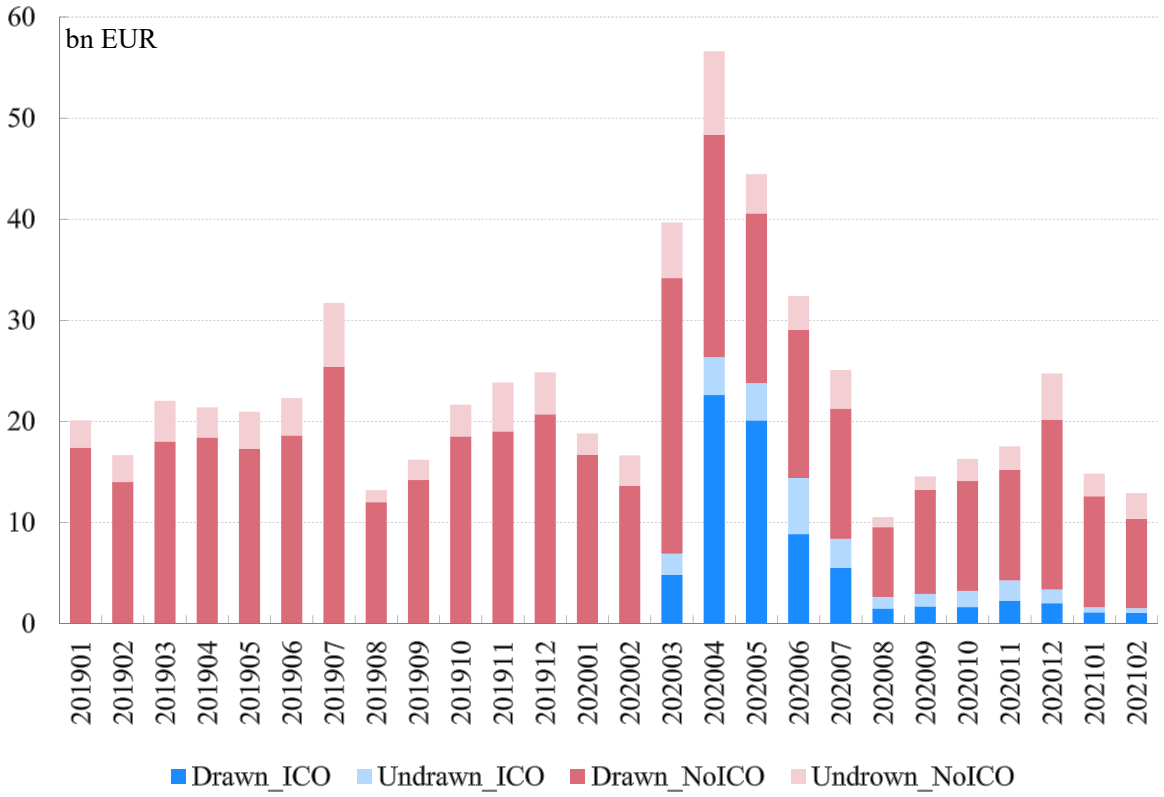
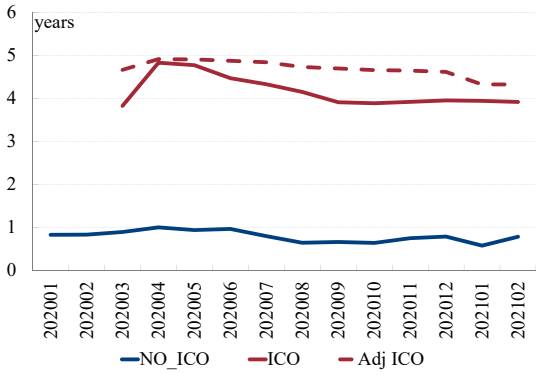
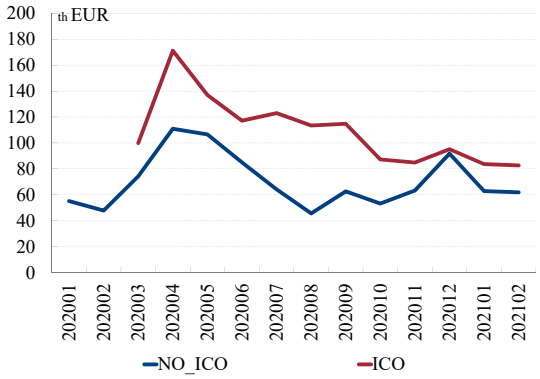


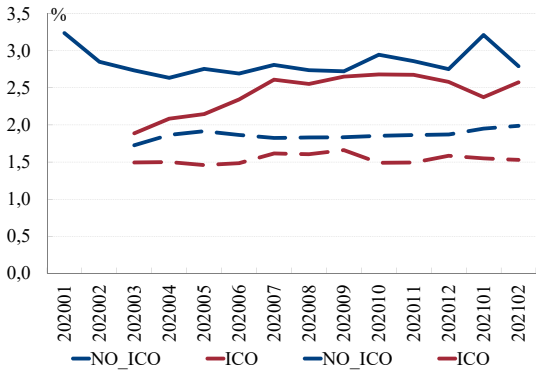
Figure OA.2: **Evolution of new credit operations to non-financial corporations (NFCs)**. This figure shows the evolution of new credit, drawn and undrawn, to NFCs from January 2019 to February 2021, distinguishing the portion arranged through the ICO facility.



(a) Maturity



(b) Size



(c) Interest Rates

Figure OA.3: **Conditions of new loans with and without public guarantees.** Panel (a) shows the average maturity of ICO and non-ICO loans, with dashed line conditioning on drawn ICO loans (i.e., excluding credit lines). Panel (b) shows the average size of ICO and non-ICO loans. Panel (c) shows the average interest rate (without fees) for both type of loans, with dashed lines adjusting by type of loan, maturity, reference rate (fixed or floating), and the existence of real or personal guarantees.

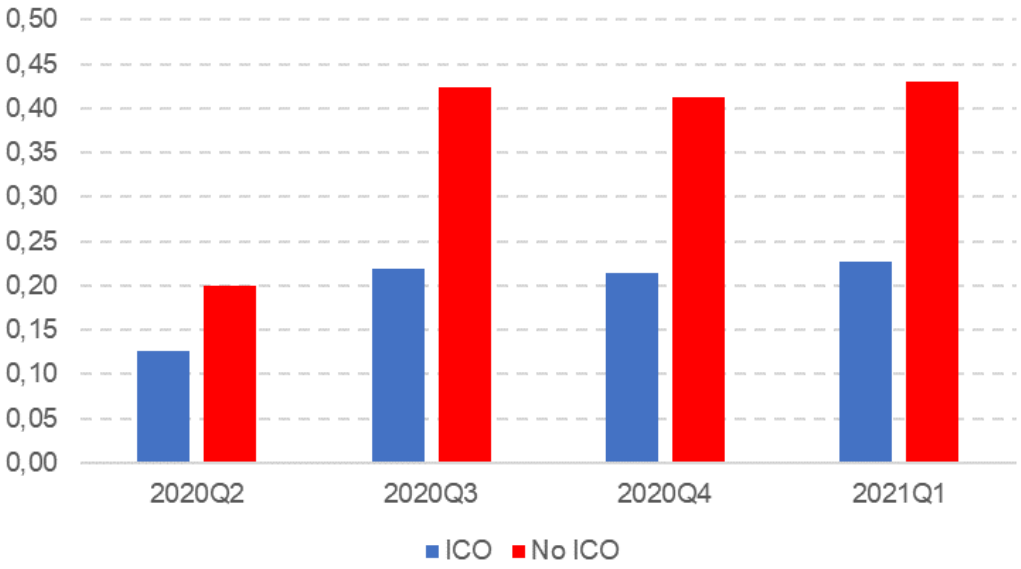


Figure OA.4: **Average Loan Fees (in %)**. This figure reports average fees for loans with and without public guarantees. Average fees for loans with guarantees are obtained directly from loan-level information. Average fees for loans without guarantees are instead based on aggregate monthly information on all new operations, and they are computed by comparing the weighted average of fees on loans with guarantees and the average fees on all new operations.

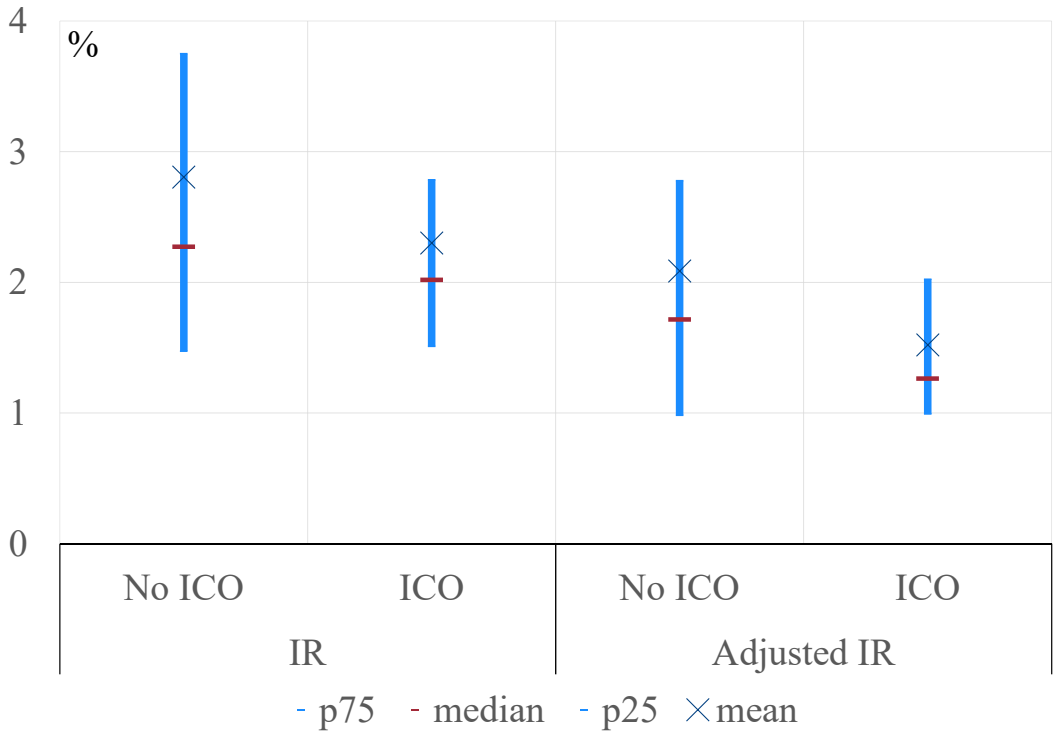


Figure OA.5: **Dispersion in the interest rates of loans with and without ICO guarantees.** This figure reports the mean, median and the 25th and 75th percentiles of interest rates without public guarantees (No ICO) and with public guarantees (ICO). The left panel corresponds to the nominal rates whereas the right panel corresponds to the nominal rates adjusted by type of loan, maturity, reference rate (fixed or floating), and the existence of other real or personal guarantees.

Table OA.1: **Distribution of new credit across bank–firm relationships.** This table reports the distribution of newly extended credit, with and without public guarantees, over the period from March 2020 to February 2021, by the credit relationship between the borrowing firm and the lending bank as of February 2020. We distinguish four categories: (i) the firm had no outstanding credit with any bank; (ii) the lending bank was the firm's main bank, as indicated by the total outstanding credit amount; (iii) the firm held credit with the lending bank, but it was not its main lender; and (iv) the firm had no prior credit with the lending bank but held credit with other banks. Column (1) reports the distribution of credit with public guarantees and column (2) the distribution of credit without public guarantees (in %).

	ICO Credit	No ICO Credit
With no previous bank relationships	15.5	20.3
From the main bank	31.8	24.1
From other banks with credit outstanding	44.3	45.2
From a new bank	8.4	10.4

Table OA.2: **Firms' access to ICO loans. Dealing with rollovers/renewals.** This table reports the results obtained from the estimation of equation (22) but using different samples of loans to define the dependent variable. Column (1) is column (1) of Table 2, our baseline and the dependent variable is the ratio of the total amount of new ICO loans with a maturity at origination above six months obtained by a given firm during the period March 2020 to February 2021 over the total amount of new loans (ICO and non-ICO loans) with similar maturity obtained during the same period. In column (2) we use all loans with a maturity at origination above one year to obtain the dependent variable whereas in column (3) we exclude loans that are renewed over our sample period. Finally, in column (4) we use the full loan sample of loans without accounting for renewals or rollovers. All columns are estimated with a set of explanatory variables that enable us to control for firm profitability, size, leverage, and liquidity; and with industry-location-size fixed effects. Industry corresponds to the 4-digit NACE code, location is defined at the zip-code level, size corresponds to four categories of firms according to the EC definition of size (micro, small, medium-sized and large firms). Standard errors (in brackets) are clustered by firm. *, **, and *** denote significance at the 10%, 5%, and 1% level (two-tail) respectively.

	(1) Baseline Mat $> 6m$	(2) Mat $> 12m$	(3) Exc Renew	(4) All
PD20 $> 1\%$	0.032***	0.044***	0.036***	0.034***
	[0.004]	[0.004]	[0.004]	[0.004]
Observations	95,370	89,464	94,618	99,008
R-squared	0.384	0.396	0.391	0.388
Firm Controls	YES	YES	YES	YES
Industry-Location-Size FE	YES	YES	YES	YES

Table OA.3: **Credit supply to captive borrowers: alternative definitions of vulnerability and fixed effects.** This table examines the robustness of the baseline specification in column (2) of Table 3, reproduced in column (1). The dependent variable is the ratio of the amount of new ICO-guaranteed loans with a maturity at origination above six months obtained by firm f from bank b between March 2020 and February 2021 to the total amount of new credit (ICO and non-ICO loans) with comparable maturity obtained by the firm from the same bank over the same period. Captive is the interaction between firm vulnerability and a previous credit relationship with the bank; Vulnerable and Relationship are its two components. Columns (1)–(3) use the baseline definition: a firm is vulnerable if its PD in 2019 exceeds 1% or its available current assets are insufficient to cover its estimated 2020 liquidity needs. Columns (4)–(9) use alternative definitions based only on default probabilities: a PD above 1% in either 2019 or 2020 (columns (4)–(6)), and a PD above 1% in 2019 (columns (7)–(9)). Within each definition, the first column includes industry–location–size–risk fixed effects, as in the baseline; the second, industry–location–size fixed effects; and the third, firm fixed effects. All specifications include bank fixed effects, and all except those with firm fixed effects include controls for pre-pandemic firm profitability, size, leverage, and liquidity. Industry corresponds to the 4-digit NACE code, location is defined at the zip-code level, and size corresponds to four categories of firms according to the EC definition of size (micro, small, medium-sized, and large firms). The risk component of the fixed effects is defined using Credit Quality Step (CQS) categories based on firms' one-year probability of default estimated using balance-sheet information as of the end of 2020. Standard errors, reported in brackets, are clustered at the firm and bank levels. *, **, and *** denote significance at the 10%, 5%, and 1% level (two-tail), respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Baseline: PD19 > 1% or Liq Needs20			PD19 or PD20 > 1%			PD19 > 1%		
Captive (Vulnerable x Relationship)	0.042***	0.049***	0.032***	0.046***	0.050***	0.034***	0.034***	0.039***	0.029***
	[0.008]	[0.008]	[0.008]	[0.010]	[0.008]	[0.009]	[0.008]	[0.008]	[0.007]
Vulnerable	-0.015*	-0.012		-0.008	-0.012		0.003	-0.000	
	[0.008]	[0.017]		[0.009]	[0.017]		[0.009]	[0.017]	
Relationship	0.001	-0.006	0.014	-0.003	-0.010	0.011	0.007	0.000	0.018*
	[0.016]	[0.021]	[0.011]	[0.015]	[0.020]	[0.011]	[0.017]	[0.021]	[0.010]
Observations	246,600	278,273	212,080	246,600	278,273	212,080	246,600	309,600	234,346
R-squared	0.545	0.504	0.574	0.545	0.504	0.574	0.545	0.498	0.573
Firm Controls	YES	YES	NO	YES	YES	NO	YES	YES	NO
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry-Location-Size-Risk FE	YES	NO	NO	YES	NO	NO	YES	NO	NO
Industry-Location-Size FE	NO	YES	NO	NO	YES	NO	NO	YES	NO
Firm FE	NO	NO	YES	NO	NO	YES	NO	NO	YES

Table OA.4: **Pass-through of credit guarantees: Alternative definitions of captive borrowers.** This table examines the robustness of the baseline specification in column (2) of Table 4 to alternative definitions of captivity. The dependent variable is the interest rate (in %) on a loan granted by bank b to firm f. Column (1) reports the baseline specification and is equivalent to column (2) of Table 4. A firm is considered captive by a given bank if it had a previous credit relationship with that bank and either its PD in 2019 exceeds 1% or its available current assets at the end of 2019 are insufficient to cover its estimated 2020 liquidity needs. Column (2) defines captivity based on a previous credit relationship and a PD above 1% in either 2019 or 2020, while column (3) uses a previous credit relationship and a PD above 1% in 2019. All specifications include controls for pre-pandemic firm profitability, size, leverage, and liquidity; bank–time fixed effects; industry–location–size–risk fixed effects; and loan contract fixed effects. Industry corresponds to the 4-digit NACE code, location is defined at the zip-code level, and size corresponds to four categories according to the EC definition (micro, small, medium-sized, and large firms). The risk component of the fixed effects is defined using Credit Quality Step (CQS) categories based on firms' one-year probability of default estimated using balance-sheet information as of the end of 2020. The contract fixed effects interact maturity buckets, interest-rate structure (fixed or floating), and origination month. Standard errors (in brackets) are clustered by firm and bank. *, **, and *** denote significance at the 10%, 5%, and 1% level (two-tailed), respectively.

	(1)	(2)	(3)
Captive defined by	Baseline	PD19 or PD20 > 1%	PD19 > 1%
ICO loan	-0.447***	-0.446***	-0.451***
	[0.142]	[0.140]	[0.146]
Captive	-0.002	0.008	-0.006
	[0.048]	[0.059]	[0.046]
Captive x ICO Loan	0.192***	0.179***	0.203***
	[0.057]	[0.065]	[0.056]
Observations	374,419	374,419	374,419
R-squared	0.753	0.752	0.753
Firm Controls	YES	YES	YES
Bank-Time FE	YES	YES	YES
Industry-Location-Size-Risk FE	YES	YES	YES
Loan Controls	YES	YES	YES

Table OA.5: **Pass-through of credit guarantees: Alternative loan samples.** This table examines the robustness of the baseline specification in column (2) of Table 4 to alternative loan-sample restrictions. The dependent variable is the interest rate (in %) on a loan granted by bank b to firm f. Column (1) reports the baseline specification and is equivalent to column (2) of Table 4. Column (2) restricts the sample to loans with a maturity at origination above one year, while column (3) excludes refinancing operations. A firm is considered captive by a given bank if it had a previous credit relationship with that bank and either its PD in 2019 exceeds 1% or its available current assets at the end of 2019 are insufficient to cover its estimated 2020 liquidity needs. All specifications include controls for pre-pandemic firm profitability, size, leverage, and liquidity; bank–time fixed effects; industry–location–size–risk fixed effects; and loan contract fixed effects. Industry corresponds to the 4-digit NACE code, location is defined at the zip-code level, and size corresponds to four firm categories according to the EC definition: micro, small, medium-sized, and large firms. The risk component of the fixed effects is defined using Credit Quality Step (CQS) categories based on firms' one-year probability of default estimated using balance-sheet information as of the end of 2020. The loan contract fixed effects interact maturity buckets, interest-rate structure (fixed or floating), and origination month. Standard errors (in brackets) are clustered by firm and bank. *, **, and *** denote significance at the 10%, 5%, and 1% level (two-tailed), respectively.

	(1) Baseline	(2) Mat>1y	(3) No ref
ICO loan	-0.447***	-0.325***	-0.431***
	[0.142]	[0.121]	[0.119]
Captive	-0.002	0.008	-0.018
	[0.048]	[0.059]	[0.052]
Captive x ICO Loan	0.192***	0.149**	0.238***
	[0.057]	[0.071]	[0.059]
Observations	374,419	292,112	239,985
R-squared	0.753	0.746	0.801
Firm Controls	YES	YES	YES
Bank-Time FE	YES	YES	YES
Industry-Location-Size-Risk FE	YES	YES	YES
Loan Controls	YES	YES	YES

Table OA.6: **Pass-through of credit guarantees: Alternative fixed effects.** This table examines the robustness of the baseline specification in column (2) of Table 4 to alternative fixed effects. The dependent variable is the interest rate (in %) on a loan granted by bank b to firm f. The explanatory variables of interest are: (i) a dummy variable indicating whether the firm is captive to the bank granting the loan, (ii) a dummy variable indicating whether the loan has an ICO guarantee, and (iii) the interaction between these two variables. A firm is considered captive to a given bank if it had a previous credit relationship with that bank and either its PD in 2019 exceeds 1% or its available current assets at the end of 2019 are insufficient to cover its estimated 2020 liquidity needs. Column (1) reproduces the baseline specification, which includes bank-time and industry-location-size-risk fixed effects. Whenever risk enters the fixed effects, it is measured using balance-sheet information as of the end of 2020, except in column (2), where it is measured using balance-sheet information as of the end of 2019. The remaining columns consider alternative sets of fixed effects: (i) bank-time and industry-location-size-risk fixed effects (column (2)); (ii) bank-time and industry-location-size fixed effects (column (3)); (iii) industry-location-size-risk fixed effects (column (4)); (iv) bank-time and industry-location-size-risk-time fixed effects (column (5)); (v) bank-industry-location-size-risk-time fixed effects (column (6)); (vi) bank-time and firm fixed effects (column (7)); and (vii) bank-time and firm-time fixed effects (column (8)). All specifications include loan controls, while firm controls are included in all specifications except columns (7) and (8). Standard errors (in brackets) are clustered by firm and bank. *, **, and *** denote significance at the 10%, 5%, and 1% levels (two-tailed), respectively.

	(1) Baseline	(2) Risk 2019	(3) No risk	(4) No bank-time	(5) Cell-time	(6) Bank-cell-time	(7) Firm	(8) Firm-time
ICO loan	-0.447***	-0.450***	-0.449***	-1.033***	-0.339**	-0.391*	-0.455***	-0.322***
	[0.142]	[0.143]	[0.150]	[0.212]	[0.131]	[0.203]	[0.118]	[0.114]
Captive	-0.002	-0.016	0.079*	-0.310***	-0.046	0.005	-0.039	-0.077*
	[0.048]	[0.054]	[0.047]	[0.117]	[0.045]	[0.044]	[0.048]	[0.046]
Captive x ICO Loan	0.192***	0.203***	0.205***	0.462***	0.200***	0.148*	0.191***	0.190***
	[0.057]	[0.062]	[0.071]	[0.095]	[0.054]	[0.076]	[0.045]	[0.049]
Observations	374,419	375,576	396,898	374,671	190,780	107,090	350,848	171,086
R-squared	0.753	0.750	0.723	0.636	0.850	0.930	0.773	0.869
Firm Controls	YES	YES	YES	YES	YES	YES	NO	NO
Bank-Time FE	YES	YES	YES	NO	YES	NO	YES	YES
Industry-Location-Size-Risk2020 FE	YES	NO	NO	YES	NO	NO	NO	NO
Industry-Location-Size-Risk2019 FE	NO	YES	NO	NO	NO	NO	NO	NO
Industry-Location-Size FE	NO	NO	YES	NO	NO	NO	NO	NO
Industry-Location-Size-Risk2020-Time FE	NO	NO	NO	NO	YES	NO	NO	NO
Bank-Industry-Location-Size-Risk2020-Time FE	NO	NO	NO	NO	NO	YES	NO	NO
Firm FE	NO	NO	NO	NO	NO	NO	YES	NO
Firm-Time FE	NO	NO	NO	NO	NO	NO	NO	YES
Loan Controls	YES	YES	YES	YES	YES	YES	YES	YES

Table OA.7: **Pass-through of ICO guarantees to captive borrowers: alternative vulnerability thresholds.** This table examines the robustness of the baseline specification in column (2) of Table 4 to alternative probability-of-default thresholds used to identify vulnerable firms in the definition of captivity. The dependent variable is the interest rate on new loans granted between March 2020 and February 2021 (in %). ICO loan is a dummy variable that equals one for ICO-guaranteed loans and zero for non-ICO loans. Captive is defined as the interaction between firm vulnerability and the existence of a previous credit relationship with the bank. In column (1), corresponding to the baseline specification, a firm is considered vulnerable if its PD in 2019 exceeds 1% or its available current assets are insufficient to cover its estimated 2020 liquidity needs. Columns (2) and (3) raise the 2019 PD threshold to 1.5% and 3%, respectively, while maintaining the liquidity-needs criterion. Column (4) uses the 3% PD threshold and restricts the sample to firms with a 2019 PD below 1% or above 3%, thereby excluding firms with intermediate default risk. Raising the threshold to 3% moves firms with a PD between 1% and 3% into the comparison group; dropping these firms restores the effect, which indicates that firms with intermediate default risk behave like captive firms. All specifications include controls for pre-pandemic firm profitability, size, leverage, and liquidity, loan controls, bank–time fixed effects, and industry–location–size–risk fixed effects. Industry corresponds to the 4-digit NACE code, location is defined at the zip-code level, and size corresponds to four categories of firms according to the EC definition of size (micro, small, medium-sized, and large firms). The risk component of the fixed effects is defined using Credit Quality Step (CQS) categories based on firms' one-year probability of default estimated using balance-sheet information as of the end of 2020. Standard errors, reported in brackets, are clustered at the firm and bank levels. *, **, and *** denote significance at the 10%, 5%, and 1% level (two-tail), respectively.

	(1)	(2)	(3)	(4)
Sample	Full sample	Full sample	Full sample	Excl. PD19 1–3%
PD19 threshold	Baseline: 1%	1.5%	3%	3%
ICO loan	-0.447***	-0.403***	-0.336**	-0.357**
	[0.142]	[0.141]	[0.132]	[0.141]
Captive	-0.002	0.011	0.073*	0.121**
	[0.048]	[0.034]	[0.043]	[0.052]
Captive x ICO Loan	0.192***	0.186***	0.032	0.089*
	[0.057]	[0.045]	[0.053]	[0.051]
Observations	374,419	374,419	374,419	130,210
R-squared	0.753	0.752	0.752	0.782
Firm Controls	YES	YES	YES	YES
Bank-Time FE	YES	YES	YES	YES
Industry-Location-Size-Risk FE	YES	YES	YES	YES
Loan Controls	YES	YES	YES	YES

Table OA.8: **Additional characteristics of ICO loans: Captive vs. non-captive.** This table reports the results obtained from a variation of equation (24) in which we estimate whether the characteristics of ICO loans for captive firms differ from those for non-captive firms. To this aim, we restrict the sample to ICO loans and estimate the coefficient associated with the dummy variable that denotes whether the firm is captive to the bank that grants the loan in equation (24). A firm is considered captive to a given bank if it had a previous credit relationship with that bank and either its PD in 2019 exceeds 1% or its available current assets at the end of 2019 are insufficient to cover its estimated 2020 liquidity needs. Column (1) contains the results obtained when the dependent variable is the interest rate of a given loan granted by bank b to firm f (in %). The dependent variable in column (2) is the logarithm of loan size, whereas in column (3) the dependent variable is the time-to-maturity at origination (in years). All specifications include controls for pre-pandemic firm profitability, size, leverage, and liquidity; bank–time fixed effects; industry–location–size–risk fixed effects; and loan contract fixed effects. Industry corresponds to the 4-digit NACE code, location is defined at the zip-code level, and size corresponds to four firm categories according to the EC definition: micro, small, medium-sized, and large firms. The risk component of the fixed effects is defined using Credit Quality Step (CQS) categories based on firms' one-year probability of default estimated using balance-sheet information as of the end of 2020. The loan contract fixed effects interact maturity buckets, interest-rate structure (fixed or floating), and origination month. Standard errors (in brackets) are clustered by firm and bank. *, **, and *** denote significance at the 10%, 5%, and 1% level (two-tailed), respectively.

	(1) InterestRate	(2) Log(Size)	(3) Maturity
Captive	0.124***	0.540***	-0.026
	[0.017]	[0.102]	[0.034]
Observations	214,562	225,278	225,278
R-squared	0.666	0.545	0.378
Firm Controls	YES	YES	YES
Bank-Time FE	YES	YES	YES
Industry-Location-Size-Risk FE	YES	YES	YES
Loan Controls	YES	YES	YES

OA.5 Proofs for Section 4

Proof of Proposition 5. With a fee ϕ, a bank's expected revenue from contract $\{B, x\}$, net of the fee and of the scarcity value of guarantees, is $p_A(B) \cdot B + (1 - p_A(B) - \rho - \phi) \cdot x$, where ρ is the shadow value of the volume constraint. Replicating the proof of Proposition 3 with ρ replaced by $\sigma \equiv \rho + \phi$ throughout: (i) the bank's zero-profit condition for solvent entrepreneurs becomes $p_A \cdot B + (1 - p_A - \sigma) \cdot x = b + k$; (ii) the Nash problem for captive entrepreneurs has bank surplus $p_A \cdot B + (1 - p_A - \sigma) \cdot x - \lambda - k$; and (iii) guarantees are allocated if and only if $1 - p_A \geq \sigma$. Hence every equilibrium object depends on (ρ, ϕ) only through σ. Market clearing,

$$\int \int x_{A,b}(\sigma) \cdot dF(A) \cdot dG(b) = \bar{X},$$

then pins down $\sigma = \rho^0$ whenever the implied $\rho = \rho^0 - \phi$ is non-negative, i.e., for all $\phi \leq \rho^0$. The proposition follows: allocations and contracts are invariant, banks' per-unit scarcity rent is $\rho = \rho^0 - \phi$, and the Nash outcome with captive entrepreneurs, which depends only on σ, is unchanged. For $\phi > \rho^0$, demand at $\sigma = \phi$ falls short of $\bar{X}$, so $\rho = 0$ and the allocation is given by $\{A : 1 - p_A \geq \phi\}$, strictly smaller than under $\phi \leq \rho^0$. □

Proof of Proposition 6. Since the supply of guarantees is unbounded, any implicit positive price for coverage is competed away: a bank charging $\rho > 0$ per unit is undercut by a competitor offering the same contract with $\rho' \in (0, \rho)$, as coverage is costless and in excess supply. Hence $\rho = 0$. Attaching maximal coverage $x = \alpha k$ weakly increases the joint surplus of any bank-entrepreneur pair (it adds $(1 - p_A)\alpha k > 0$ of expected transfers at no cost), so all loans carry full allowed coverage. For solvent entrepreneurs, competition drives bank profits to zero, yielding the contract $p_A(B_{A,b}) \cdot B_{A,b} + (1 - p_A(B_{A,b})) \cdot \alpha k = b + k$; the entrepreneur's expected repayment falls by exactly $(1 - p_A)\alpha k$ relative to the no-guarantee contract, i.e., pass-through is complete. For captive entrepreneurs, the Nash problem is that of the proof

of Proposition 3 with $x = \alpha k$ and $\rho = 0$; the solution is a weighted average of $\bar{B}_A(\alpha)$ ($\gamma = 1$) and $\underline{B}_A(\alpha)$ ($\gamma = 0$), with weight increasing in γ by the same monotonicity argument. The thresholds are

$$A_h(b;\alpha) \equiv \{A:\ \bar{p}_A(\alpha)\cdot\bar{B}_A(\alpha) + (1-\bar{p}_A(\alpha))\cdot\alpha k = b + k\},$$
$$A_\ell(b;\alpha) \equiv \{A:\ \bar{p}_A(\alpha)\cdot\bar{B}_A(\alpha) + (1-\bar{p}_A(\alpha))\cdot\alpha k = \lambda + k\},$$

for $b > \lambda$ (with the obvious analogue of Equation (32) for $b \leq \lambda$). By the envelope theorem, the maximized bank revenue $\max_B\ p_A(B)B + (1-p_A(B))\alpha k$ is strictly increasing in α (its derivative is $(1-\bar{p}_A(\alpha))k > 0$), so both thresholds are strictly decreasing in α. For part 3, index equilibrium effort by design: $p_A(\alpha^*)$ under $\langle\infty, \alpha^*\rangle$ and p_A^0 under $\langle\bar{X}, 1\rangle$. Conditional on coverage, the solvent entrepreneur's expected repayment is $b + k - (1-p)\cdot\alpha^* k$ under the former and $b + k - (1-p-\rho^0)\cdot k$ under the latter, each evaluated at its own equilibrium effort; both reductions decrease in p, and effort and surplus increase as the expected repayment falls. Whichever design offers the larger reduction at the *other* design's equilibrium effort therefore delivers the lower equilibrium repayment. At any common p, the ample-partial reduction is larger if and only if $\rho^0 > (1-\alpha^*)\cdot(1-p)$; hence $\rho^0 \geq (1-\alpha^*)\cdot(1-p_A^0)$ is sufficient for the solvent entrepreneur to gain from the switch, and $\rho^0 < (1-\alpha^*)\cdot(1-p_A(\alpha^*))$ is sufficient for her to lose. For part 2, consider an entrepreneur who is captive under both designs. At $\gamma = 1$ the captive entrepreneur's repayment under coverage α is her maximum debt capacity, $\bar{B}_A(\alpha) \in \arg\max_B\ p_A(B)\cdot B + (1-p_A(B))\cdot\alpha k$; under the limited-full design it is $\bar{B}_A^g = \bar{B}_A(1)$, since the ρ-term in Definition 2 does not vary with B and hence does not affect the maximizer. The first-order condition $\Phi(B,\alpha) \equiv p_A(B) + p_A'(B)\cdot(B - \alpha k) = 0$ has $\Phi_B < 0$ (second-order condition) and $\Phi_\alpha = -p_A'(B)\cdot k > 0$, so $\bar{B}_A(\alpha)$ is strictly increasing in α: with $\alpha^* < 1$, the captive's repayment is strictly lower – and her surplus $p_A(B)\cdot(A-B) - C(p_A(B))$, strictly decreasing in B, strictly higher – under the ample-partial design. Finally, the bank's revenue from a captive entrepreneur, $V(\alpha) \equiv \bar{p}_A(\alpha)\bar{B}_A(\alpha) + (1-\bar{p}_A(\alpha))\cdot\alpha k$ with $\bar{p}_A(\alpha) \equiv p_A(\bar{B}_A(\alpha))$,

satisfies $\frac{dV}{d\alpha} = (1 - \bar{p}_A(\alpha)) \cdot k > 0$ by the envelope theorem: capture falls accordingly. □

Proof of Proposition 7. Fix ρ and $b > \lambda$, and let $\gamma = 1$. The cap applies to guaranteed loans only. Recall that guaranteed repayments rise with A for captive entrepreneurs and fall with A for solvent ones, and the two coincide at $A_h^g(b, \rho)$ where the repayment is highest. The cap therefore binds on an interval around $A_h^g(b, \rho)$, which widens as B^c falls (as illustrated in Figure 5).

Consider entrepreneurs for whom the cap binds. Recall that a bank attaches a guarantee to a loan only if it gains at least the scarcity rent ρ from it. For solvent entrepreneurs, competition drives this gain to exactly ρ at the repayment $B_{A,b}^g$. Under a binding cap the gain falls below ρ, so no outside bank lends to them with the guarantee. Those with $A \geq A_h^*(b)$ remain solvent without it and repay more than under it, since the guarantee lowers the repayment at which a bank breaks even. Those with $A_h^g(b, \rho) \leq A < A_h^*(b)$ can obtain the guarantee only from their legacy bank, whose alternative is to renegotiate their debt without it. If the legacy bank lends at the cap, they repay $B^c < B_{A,b}^g$; if not, they lose the guarantee and become captive.

For captive entrepreneurs, $A < A_h^g(b, \rho)$, the legacy bank gains more than ρ from the guarantee. It keeps the guarantee as long as its gain at the cap is at least ρ. These captives repay B^c: the cap reduces capture, and their effort and surplus increase. Captives whose legacy bank is better off without the guarantee, and hence without the cap, lose it and return to their outcome without the program.

Since the argument holds for any ρ, it also holds at the equilibrium value of ρ under the cap. The cap lowers banks' demand for guarantees, and hence ρ; by Proposition 3, this only lowers the thresholds $A_\ell^g(b, \rho)$ and $A_h^g(b, \rho)$. □

References

Falagiarda, M., A. Prapiestis, and E. Rancoita (2020): "Public loan guarantees and bank lending in the COVID-19 period," *ECB Economic Bulletin*, box 7.

Informe Anual Banco de España (2019): "Epígrafe 4: El Impacto de la pandemia en España y la respuesta de la política económica." Informe anual, Banco de España.