Cross-subsidization of Bad Credit in a Lending Crisis[*]

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Abstract

We study the corporate-loan pricing decisions of a major, systemic bank during the Greek financial crisis. A unique aspect of our dataset is that we observe both the actual interest rate and the "breakeven rate" (BE rate) of each loan, as computed by the bank's own loan-pricing department (in effect, the loan's marginal cost). We document that low-BE-rate (safer) borrowers are charged significant markups, whereas high-BE-rate (riskier) borrowers are charged smaller and even negative markups. We rationalize this de facto cross-subsidization through the lens of a dynamic model featuring depressed collateral values, impaired capital-market access, and limit pricing.

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1   Introduction

A common concern among macroeconomists and financial economists is that the credit market is distorted during a financial crisis. Specifically, banks may be reluctant to terminate loans, because of depressed collateral values. Therefore, they offer worse-performing firms an interest rate that is below the "fair rate" to keep them afloat. In an effort to make up the losses, banks may overcharge healthy and growing firms that do not have many funding alternatives during a crisis. The result is a de facto cross-subsidization of weaker firms by stronger firms, which misallocates credit and prolongs the financial crisis.

A common challenge in testing this cross-subsidization hypothesis is determining whether a given loan is upcharged or is extended at preferential terms (Acharya, Crosignani, Eisert & Steffen (2022)). Such a determination requires a benchmark value—the "fair" or "breakeven" rate (BE rate) of the loan— which in turn would allow the estimation of a positive or negative "markup." Throughout the paper, "markup" is the difference between the loan's actual and breakeven rate. By breakeven rate, we mean the interest rate that would make the lender break even, taking into account the lender's funding rate and operating costs, as well as expected losses and any regulatory charges associated with the loan. In effect, the BE rate is the marginal cost of the loan from the lender's perspective. But such a rate is typically not observable. To address this limitation, the literature typically imputes the BE rate in some indirect manner.[1] As a result, the theory ends up being tested jointly with the indirect imputation method, resulting in a "joint hypothesis" problem.

In this paper, we provide *direct* evidence in support of the cross-subsidization hypothesis. We exploit a regulatory reform, which mandated that Greek banks explicitly compute the marginal cost of each loan (i.e., BE rate) adhering to an objective, formulaic, and data-driven approach. We use a dataset that contains both breakeven and actual interest rates for each loan, allowing us to *observe* rather than infer the markup of each loan. This dataset pertains to the large corporate portfolio of a major, well-capitalized Greek bank at the height of the

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[1] To ascertain whether a bank subsidized a given firm, prior research has focused on below-prime interest rate loans (Caballero, Hoshi & Kashyap (2008); Chari, Jain & Kulkarni (2021)) and (or in conjunction with) indicators of distress based on interest coverage ratios (Acharya, Eisert, Eufinger & Hirsch (2018); McGowan, Andrews & Millot (2018); Acharya, Crosignani, Eisert & Eufinger (2020)), credit ratings (Acharya, Eisert, Eufinger & Hirsch (2019)), profitability (Banerjee & Hofmann (2018)), negative equity (Bonfim, Cerqueiro, Degryse & Ongena (2022)) and under-reported losses (Blattner, Farinha & Rebelo (2019)).

recent Greek financial crisis.[2]

Our main finding is that the bank charges an interest rate well above the BE rate to comparatively safe (low-BE rate) borrowers. By contrast, the bank charges a small, and sometimes even negative, markup to its riskier (high-BE rate) loans.[3] This de facto "cross-subsidization" of riskier by safer borrowers occurs despite *observable* differences between borrowers, as reflected in their breakeven rates; it is not the result of simply pooling borrowers with *unobservable* differences.

To provide a framework for our empirical results, we start by building a dynamic corporate finance model. The model is tailored to capture the specific institutional and historical context of our empirical analysis, but its key features are fairly standard and broadly used in the literature. In the model, a borrower needs funds and a competitive bank provides them. We study this model during a "crisis" and a "post-crisis" state. In the post-crisis state, the bank has frictionless access to capital markets and collateral values are high enough that terminating low-profitability borrowers is profitable. With these assumptions, in the post-crisis state, the interest rate of each loan is simply the funding cost of the bank plus the default risk of each loan.

By contrast, when the economy is in a crisis, our main assumptions are that (a) the bank loses its frictionless access to capital markets (i.e., has limited or no access to new capital) and (b) collateral values are temporarily depressed. As a result, we show that loan pricing differs for low-profitability and high-profitability borrowers. The interest rate for low-profitability borrowers is disconnected from—and may even be lower than—the loan's marginal cost, because of the real option to wait until either collateral values or firm productivity rebound. For such borrowers, the bank simply extracts what each low-profitability borrower can afford to pay. At the same time, the reluctance of competitor banks to terminate their own low-productivity projects and their inability to raise new capital in international financial markets implies that high-profitability borrowers cannot be poached easily by competitors. Thus, they can be charged a positive markup, up to the point where competitor banks are indifferent

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[2]This bank, like every systemic bank in Greece during that period, was recapitalized and passed strict stress tests by the European Banking Authority (EBA).

[3]Specifically, we find that 14.6% of the loans in our sample feature an actual rate that is at least 100 bps below the BE rate, with an average markup of -4.02%.

between poaching the loan or not ("limit pricing").

The theoretical model makes three basic predictions: First, a cross-sectional regression of actual loan rates on their breakeven rates should have a coefficient *less than one*, reflecting that financially healthier borrowers are upcharged, relative to weaker ones(imperfect "pass-through").[4] Second, a deepening (abatement) of the financial crisis, modeled as an aggregate increase (decrease) in the opportunity cost of funding a loan, should reduce (increase) the pass-through of breakeven to actual rates. Third, the pass-through of the breakeven rate to actual rates should be *asymmetric*: the pass-through coefficient should be higher for high-profitability firms, whose loans are priced according to a limit pricing rule, and weaker for firms whose loans are priced according to what the borrower can afford to pay.

We test these three predictions using a dataset that includes the universe of large-firm loans of a major, systemic bank in Greece. As mentioned above, we exploit a regulatory reform mandating that banks develop new, transparent loan-level pricing guidelines. This requirement was imposed by the the monitoring institutions of the Greek Memorandum of Understanding (MoU) following the recapitalization of Greek banks in 2012.

In response to these mandates, each systemic bank had to develop its own pricing model independently, adhering to two requirements. First, the pricing model had to be formulaic and data driven (i.e., use exogenous risk-assessments and balance-sheet information), follow the Basel guidelines, and be used to compute capital charges at the loan level. Second, it had to be applied uniformly to all loans of the same class with common parameters for non-firm-specific variables. Both requirements aimed to prevent model manipulation (as in Behn, Haselmann & Vig (2022)) by excluding subjective and internal risk assessments and by implementing the same pricing rules across borrowers. The ultimate output was a *loan-level* breakeven rate, defined as the interest rate that makes the bank break even on the loan. Importantly, for loans extended with interest rates below the BE rate, the new framework required internal approval that stated the justification for the discount.

The introduction of the new pricing guidelines (in early 2015) allows us to test for imperfect pass-through of the breakeven on the actual rate. Consistent with the first prediction

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[4]A mathematically equivalent formulation of the imperfect pass-through hypothesis is that the difference between the actual and BE rate (the markup) is decreasing in the BE rate.

of our theoretical model, the coefficient of a regression of the actual rate on the BE rate is always below 1, implying markups are decreasing in the breakeven rate. This finding is pervasive; we even observe that a non-trivial number of loans are extended at below-BE rates, with loan managers choosing to go through the arduous internal-approval process.

We use the dramatic events of May-July 2015 (that brought Greece to the brink of sovereign default) to test the second prediction of our model, i.e., whether a deepening (abatement) of the financial crisis leads to a weaker (stronger) pass-through. We show that as Greece starts nearing default because of the failed negotiations with its official creditors (May-June 2015), the pass-through from breakeven to actual rates is effectively zero. Once the Greek government unexpectedly changes its policy stance, and agrees to a new memorandum (July 13, 2015), the pass-through coefficient jumps to a level around 0.5.

Finally, we also document a pricing asymmetry that is consistent with the third prediction of our theoretical model. The pass-through coefficient—controlling for time and firm fixed effects—is about 0.4 for relatively safe (below-median BE rate) borrowers, but is essentially zero for relatively risky (above-median BE rate) borrowers. This finding is consistent with the view that the pricing decisions for the riskier borrowers are decoupled from the riskiness of their loan, and are mostly dictated by the borrower's ability to pay.

We examine several alternative interpretation of our results. First, we test whether the limited pass-through of the actual on the breakeven rate is simply the result of loan managers ignoring the breakeven rate. It is straightforward to test this hypothesis by examining the loan pricing decisions pre- and post-introduction of the new pricing guidelines. Specifically, we show that the introduction of the new pricing guidelines in 2015 had a profound impact on loan pricing, with loan managers heeding the requirement to use the breakeven rate as a basis for pricing new loans. We find that for a 1% discrepancy between the initial BE rate and the prior year's actual rate, the interest rate charged to the same borrower rises by 40 bps. Indeed, the BE rate appears to be the only variable that matters for loan pricing after the introduction of the new pricing guidelines. Variables capturing non-economic factors (e.g., political, banking, media connections of board members, family equity ownership, etc.) seem to matter for loan pricing during the pre-guideline period, but are driven out post-guideline. Our results suggest that the implementation of the new pricing guidelines had a material

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impact and mitigated non-economic influences on loan pricing decisions.

Second, we test whether our limited pass-through result is driven by loan managers' foresight about the future prospects of the firm that are not reflected in the current BE rate. Utilizing a test analogous to Chiappori & Salanie (2000), we examine whether a low (high) markup correlates with subsequent improvement (deterioration) in the borrower's credit rating. We find that the markup has no ability to predict future changes in the borrower's credit rating—after controlling for the current credit rating. Therefore, the source of the imperfect pass-through is not due to managers' possessing some superior information on the long-term prospects of the firm, which induces them to moderate the impact of the BE rate on their loan-pricing decisions. Additionally, we find that the qualitative justifications provided for negative markups are strongly correlated with the BE rate, but not with the magnitude of the (negative) markup. This result implies that justifications depend on the loan riskiness (BE rate) rather than the length and strength of the banking relationship, which are not inputs into the BE rate.

Finally, the set of the bank's clients remains relatively stable across the entire period and we do not find any obvious relation between the balances, or frequency of new loans and changes in the BE rate or the magnitude of the markup. These findings are consistent with both safer and riskier borrowers remaining in relationship with the bank during the lending crisis, as our theoretical model predicts.

Our results relate to several strands of the literature. Past studies on "zombie lending" have examined the widespread practice by Japanese banks in the 90s to provide credit to insolvent firms (Peek & Rosengren (2005); Caballero et al. (2008); Giannetti & Simonov (2013)), before shifting focus to Europe during the sovereign debt crisis.[5] More recently, Faria-e Castro, Paul & Sanchéz (2021) provide evidence of "evergreening" in the US using supervisory data from the Federal Reserve. Even though our study is related to the literature on zombie lending, our paper is not just about zombie loans, because we can observe both positive and negative markups at the loan level. Our setting allows for a direct test of the cross-subsidization hypothesis, without having to rely on some indirect inference for

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[5]See Albertazzi & Marchetti (2010); Banerjee & Hofmann (2018); McGowan et al. (2018); Acharya et al. (2019); Blattner et al. (2019); Acharya, Imbierowicz, Steffen & Teichmann (2020); Acharya, Crosignani, Eisert & Eufinger (2020); Schivardi, Sette & Tabellini (2021); Bonfim et al. (2022)).

the "fair" (or "breakeven") rate of each loan. To illustrate the benefit of having a direct measure of the breakeven rate, in Section 7 we perform the following exercise: We use the commonly used indirect inference approaches in the literature to test whether they would correctly identify the subsidized loans in our sample. We show that these indirect inference approaches can be both noisy and subject to sample selection issues.

A large literature investigates "cross-subsidization," especially in asymmetric-information settings. Puelz & Snow (1994) and Chiappori & Salanie (2000) provide early examples of testing for cross-subsidization from safe consumers to risky consumers in the auto insurance market. Similar notions of cross-subsidization have been examined in other areas including the mortgage market (Hurst, Keys, Seru & Vavra (2016); Gambacorta, Guiso, Mistrulli, Pozzi & Tsoy (2019)), student loans (Bachas (2019)), and health insurance (Finkelstein (2004), Finkelstein & McGarry (2006), Aizawa & Kim (2018)). In a recent paper, Nelson (2020) shows a regulatory change in the US credit card market restricted cross-sectional pass-through across credit card consumers, thus providing cheaper credit to risky consumers while safe consumers received overpriced credit. Our notion of "cross-subsidization" differs from the above literature, where cross-subsidization is typically the result of *pooling* clients who seem similar on observables. In our context, the bank *knowingly and willingly* cross-subsidizes borrowers exhibiting observably different risk characteristics (i.e., BE rates). Our notion of cross-subsidization also differs from the literature where cross-subsidies are the result of behavioral biases.[6]

Screening models of cross-subsidization provide an alternative framework to ours to capture cross-subsidization of observably dissimilar clients, as revealed by the client's choices. Several reasons seem to suggest such a framework may not be well suited for the specific context we study in this paper. First, such models do not contain clear implications about the pattern of cross-subsidization. Oligopolistic screening introduces a markup but leads to ambiguous predictions as to whether the markup per dollar loaned should be increasing or decreasing with borrower riskiness.[7] Second, in such models, the markup is typically positive

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[6]This notion of cross-subsidization applies especially to the mortgage market where the cross-subsidies occur between heterogeneously attentive and sophisticated households (e.g., Fisher, Gavazza, Liu, Ramadorai & Tripathy (2023)).

[7]For instance, the oligopolistic screening model of the lending market by Villas-Boas & Schmidt-Mohr (1999) has parameter-dependent implications about whether the markup should be higher or lower for riskier

across all credit qualities,[8] whereas in our data, we observe several instances in which loan managers extend loans at below-BE rates, hinting at the presence of a "real option." Third, as mentioned earlier, in Section 8.2 we perform a test similar in spirit to the asymmetric-information test of Chiappori & Salanie (2000)[9] and find that the actual interest rate on a loan does not appear to have superior ex-post predictive ability of the sort that one would expect in a screening model. Overall, our conclusions in Section 8.2 are reminiscent of the main conclusion of Darmouni (2020), who finds that private information plays a secondary role (compared to common information) in terms of explaining the credit crunch in the syndicated corporate loan market in the US.

Our paper also relates to the literature on the efficacy and limitations of financial regulation. Glaeser & Shleifer (2001), Rajan, Seru & Vig (2015), and Behn et al. (2022) show that model complexity and agency costs may result in model manipulation. Consistent with these insights, in our setting the introduction of a formulaic, rigid, data-driven pricing model with exogenous inputs mitigates non-economic influences on loan pricing.

Due to its dynamic nature, our model resembles the large banking literature on relationship lending (Diamond (1991); Rajan (1992)). In our setting, availability of credit to weaker borrowers results not from banking relationships per se (Petersen & Rajan (1994), Hu & Varas (2021)), but is the result of temporarily depressed collateral values, whereas positive markups are the result of impeded bank competition (Boot & Thakor (2000)). Given the focus on the Greek financial crisis, the paper also contributes to the literature on impaired financial intermediation in the context of the European Sovereign Debt Crisis.[10] Several articles examine the relationship between bank market power and interest rate pass-through (Hannan & Berger (1991); Berger & Udell (1992); Neumark & Sharpe (1992); Scharfstein & Sunderam (2016); Zentefis (2020)). However, the notion of limited pass-through in our

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loans. In an industrial organization framework similar to the seminal Mussa & Rosen (1978) non-linear pricing framework, Rochet & Stole (2002) show that as competition intensifies, their oligopolistic model converges to a fixed-fee model, independent of revealed borrower characteristics.

[8]See, for example,Villas-Boas & Schmidt-Mohr (1999).

[9]Chiappori & Salanie (2000) test for a correlation between ex-ante choices of auto-insurance coverage and ex-post accidents. In our context, we test whether a seemingly low interest rate tends to predict positive revisions to a borrower's future rating.

[10]See for example, Acharya, Drechsler & Schnabl (2014); Acharya et al. (2018); Acharya, Imbierowicz, Steffen & Teichmann (2020)).

paper is primarily cross-sectional: it refers to a less than one-for-one relation between the actual and breakeven rate across different loans at the same point in time.

2 Model

In this section, we propose a stylized model to aid the interpretation of our empirical results.

We consider a basic dynamic corporate finance problem whereby a lender and a borrower split the cash flows of a project during times of "crisis" and "post-crisis." The economy is in a state of crisis at time 0. At some random, exponentially distributed time τ, the economy transits to the post-crisis state. The exit from the crisis occurs with a hazard rate ρ per unit of time dt.

Our focus is on the state of crisis. We make three main assumptions about the crisis: (a) Banks have limited access to international capital markets, (b) collateral values of all projects are depressed during this time period, and (c) shareholders had essentially no ability to perform equity injections. Our main result is that the combination of these assumptions impedes perfect competition between banks and results in a less than unitary pass-through of a loan's marginal cost to its interest rate.

We start by presenting first the post-crisis version of the model and then work backwards to present the model solution during the time of the crisis.

2.1 The post-crisis state

Throughout, we assume that a typical firm produces a stochastic cash-flow process π_t per unit of capital and per unit of time dt. For simplicity, we assume (a) each firm only uses one unit of capital, and (b) this cash-flow process takes two values according to an (idiosyncratic and firm-specific) Markov regime-switching process.[11] The cash-flow process of firm i takes the value π_i^H when the firm is in regime H and the value π_i^L when the firm is in regime L. The hazard rate of leaving regime H and transitioning to regime L is equal to p_i^L, and

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[11]Allowing multiple profitability regimes or allowing firms to choose the scale of their capital is straightforward, but is immaterial for the purposes of this paper. Abel & Panageas (2020a) present a version of this model that allows the firm to vary its scale by adjusting the units of the capital stock.

the hazard rate of the reverse transition is p_i^H. The transitions between the two regimes are independent across firms. Moreover, firms can differ in terms of the regime transition probabilities $(p_i^H,\ p_i^L)$ and cash flows $(\pi_i^H,\ \pi_i^L)$.

In the post-crisis economy, banks are perfectly competitive and can borrow and lend freely at the rate r^* in international capital markets. The (representative) bank provides the unit of the capital stock to the firm and in exchange obtains a cash-flow stream R_i^j, which depends on firm i and the profitability regime $j \in \{H, L\}$ of firm i.

We normalize the price of one unit of the capital stock to 1. At any point in time, the bank can liquidate the capital stock and obtain a value $C_i^* < 1$. In other words, the difference between the price of capital and its liquidated value, $1 - C_i^* > 0$, is the deadweight cost of bankruptcy. While keeping in mind that the firm-specific parameters can differ across firms, we henceforth drop the subscript i to economize notation, and write p^H, p^L, π^H, π^L, R^j and C.

Throughout, we abstract from corporate cash accumulation by assuming shareholders have a sufficiently high discount rate λ.[12] For simplicity, we also suppress equity issuance by assuming shareholders cannot inject any additional equity to the firm, and hence, $R^j \leq \pi^j$, for $j \in \{H, L\}$. Finally, all debt is short term (i.e., needs to be constantly rolled over) and the bank can withdraw the unit of capital at any time. Similarly, companies can refinance their loans at no cost by repaying the current bank the face value of the loan (normalized to one dollar) and obtaining a new loan from another competitive bank.

The value of a debt contract V_t from the perspective of a bank obeys a standard asset-pricing relationship. When the profitability of the firm is in regime H, the value of the debt contract is

$$\underbrace{R^H}_{\text{Interest paid to the bank}} + \underbrace{p^L\left(\max\{V^L, C^*\} - V^H\right)}_{\text{expected capital loss upon profitability change}} = \underbrace{r^* V^H}_{\text{required rate of return}}, \qquad (1)$$

where r^* is the prevailing bank's discount rate. Similarly, the pricing equation when the firm

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[12] Abel & Panageas (2020b) study a version of this model that allows for cash accumulation and show a high-enough shareholder discount rate leads to no cash accumulation.

is in regime L is

$$\underbrace{R^L}_{\text{Interest paid to the bank}} + \underbrace{p^H\left(V^H - V^L\right)}_{\text{expected capital gain upon profitability change}} = \underbrace{r^*V^L}_{\text{required rate of return}} . \tag{2}$$

Because banks are competitive, it must be the case that no bank makes rents, so that both $V^H \leq 1$ and $V^L \leq 1$. (If either V^H or V^L were above one, a competitor bank can borrow a dollar in international financial markets and offer to refinance the loan). At the same time, a bank will not initiate a loan unless it makes non-negative profits, which leads to $V^H = 1$, and hence, by equation (1), we have

$$R^H = r^* + p^L\left(1 - \max\{V^L, C^*\}\right). \tag{3}$$

We assume

$$\pi^H > r^* + p^L\left(1 - C^*\right), \tag{4}$$

which implies $R^H < \pi^H$, and hence, it is feasible for the bank to charge the interest rate R^H that allows it to break even. Using $V^H = 1$ inside (2) gives

$$R^L + p^H\left(1 - V^L\right) = r^*V^L. \tag{5}$$

The bank will find it optimal to liquidate the firm whenever $V^L < C^*$. The maximum possible value of V^L is obtained by setting $R^L = \pi^L$, in which case, equation (5) becomes

$$V^L = \frac{\pi^L + p^H}{r^* + p^H}. \tag{6}$$

We assume

$$\pi^L < \left(r^* + p^H\right)C^* - p^H, \tag{7}$$

and therefore, (6) implies $V^L < C^*$, which in turn implies liquidating the firm in regime L is optimal. We summarize the above discussion in the following proposition.

Proposition 1. *Assume conditions (4) and (7) hold. Then,*

$$R^H = r^* + p^L \left(1 - C^*\right), \tag{8}$$

and the firm gets liquidated once it enters the low-profitability regime L.

The post-crisis interest rate (8) is intuitive and familiar. The bank charges its own funding rate r^* along with an additional component reflecting the probability of default p^L times the loss upon default $(1 - C^*)$. Note that because we have allowed p^L to differ across firms, so will the interest rate R^H that the bank charges to different firms, depending on each firm's default risk.

2.2 The crisis state

The focus of our analysis is on the state of crisis. The crisis version of the model is identical to the post-crisis version, with two exceptions: (a) Collateral values are lower during the crisis period, so that liquidation of a firm allows the bank to recover only $C < C^*$ per unit of capital, and (b) banks have no access to international capital markets; therefore, they have to finance new projects using their internal funds. This second assumption is mostly for expositional ease and can be relaxed to allow banks to have costly access to capital markets, as we discuss at the end of this section. Although not essential for our results, we also allow the required rate of return of bank shareholders (r) to differ from its post-crisis level (r^*).

Throughout, superscript "c" denotes a variable during the state of crisis. Letting $V^{H,c}$ and $V^{L,c}$ denote the value of debt when a given firm i is in regimes H and L, when the economy is in the crisis state (c), we obtain the pricing equation:

$$R^{H,c} + p^L \left(V^{L,c} - V^{H,c}\right) + \rho \left(1 - V^{H,c}\right) = r V^{H,c}. \tag{9}$$

The first two terms on the left-hand side of (9) are the same as during the pre-crisis period, namely, the sum of the interest charged by the bank, $R^{H,c}$, plus the expected capital loss upon transition to the low-profitability regime, $p^L \left(V^{L,c} - V^{H,c}\right)$. The third term reflects

the expected change in the value of the debt upon transition to the post-crisis state, which is the product of the transition hazard ρ times the change in the value of debt, $1 - V^{H,c}$. Similarly, for a firm that finds itself in regime L, the debt-pricing equation is

$$R^{L,c} + p^H \left(V^{H,c} - V^{L,c} \right) + \rho \left(C^* - V^{L,c} \right) = r V^{L,c}. \tag{10}$$

Clearly, a bank will not find it profitable to liquidate a loan as long as its value exceeds its depressed collateral value, that is, if $V^{L,c} \geq C$.

The assumption that banks have to finance projects from internal funds limits competition between banks for firms in the H regime. To poach a borrower in the H regime, a rival bank has to liquidate $1/C$ of its existing loans, so that it can raise the face value of the loan it is poaching ($C \times 1/C = 1$). Clearly, the rival bank finds it profitable to engage in such poaching only if $V^{H,c} \geq \frac{D}{C}$, where D is the minimal value across all non-liquidated debt contracts that the rival bank is financing.[13] Because *all* existing debt contracts of any bank must have a value no lower than C (otherwise, they would be liquidated already), it follows that $D \geq C$, or equivalently $\frac{D}{C} \geq 1$.

In summary, unlike in the post-crisis state, where the no-poaching condition amounts to $V^H = 1$, during a crisis, the no-poaching condition leads to $V^{H,c} = \frac{D}{C}$, where $\frac{D}{C} \geq 1$. We obtain the following proposition.

Proposition 2. *Assume conditions (4) and (7) hold, and in addition, assume*

$$r^* - p^H \left(1 - C^* \right) < r \frac{D}{C} + \rho \left(\frac{D}{C} - C^* \right), \tag{11}$$

and

$$\frac{\pi^L + p^H \frac{D}{C} + \rho C^*}{r + \rho + p^H} > C. \tag{12}$$

Then, $R^{L,c} = \pi^L$ and

$$R^{H,c} = r + (r + \rho) \left(\frac{D}{C} - 1 \right) + p^L \left(\frac{D}{C} - V^{L,c} \right), \tag{13}$$

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[13]The heterogeneity of the parameters (e.g., p^H, p^L, π^H, π^L) implies that $V^{H,c}$ and $V^{L,c}$ differ across firms.

where

$$V^{L,c} = \frac{\pi^L + p^H \frac{D}{C} + \rho C^*}{r + \rho + p^H} < \frac{D}{C}. \tag{14}$$

Remark 1. *Note that (sufficiently small) values of C and (sufficiently large) values of C^* always exist, such that conditions (7) and (12) both hold.*

Proposition 2 states that in a crisis, liquidating the firm in regime L is not optimal. The intuition is that low collateral values during the crisis lead to an option value of postponing the liquidation until the economy exits the crisis.

Another interesting implication of proposition 2 is that while the economy is in a crisis, the bank makes economic "rents" from projects in regime H. To see this implication in the simplest possible way, assume the same pre- and post-crisis required rate of return, $r = r^*$, and also $\frac{D}{C} > 1$. Then, the fact that $V^H = \frac{D}{C} > 1$ implies that the expected present value of the interest paid by firms that find themselves in regime H during a crisis exceeds the value of the capital provided by the bank (whose value we have normalized to 1). The origin of this rent is the assumption that banks are cut off from capital markets during the crisis: to raise a dollar, competitor banks would have to liquidate some of their existing loans and incur liquidation costs, because they can no longer borrow freely in capital markets. These liquidation costs confer a de facto competitive advantage to the bank that currently owns the loan, because it does not need to incur liquidation costs to maintain the loan. In particular, the bank engages in "limit pricing"; that is, it sets the interest rate to the maximal level that still prevents a competitor from "poaching" the loan.

The shareholders of firms in the L regime also benefit during a crisis. In post-crisis times, the firm gets liquidated and these shareholders receive nothing. By contrast, during the crisis, liquidation is postponed, which means that the firm could revert back to the H regime, at which point the shareholders would start receiving non-zero cash flows again.[14]

This phenomenon whereby banks in a time of crisis essentially subsidize their relatively less profitable borrowers (firms in the L regime) at the expense of the more profitable borrowers (firms in the H regime) is a key prediction of our model.

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[14]Although the bank appropriates all cash flows while the firm is in the L regime $(R^{L,c} = \pi^L)$, the firm may still transit back into the H regime before the economy transitions to the post-crisis regime. Given that $R^{H,c} < \pi^H$, and that the probability of transitioning to the H regime is positive, the shareholders of the firm in regime L own a claim with a positive expected present value.

We conclude this section with a parenthetical remark. We have treated the population of firms as fixed. If we allowed firm entry, and assumed that arriving firms start out in the H regime, the high interest rates for firms in the H regime would lower new firm creation.

2.3 Empirical implications

The next proposition contains a testable prediction of the model:

Proposition 3. *The interest rate differential, $R^{L,c} - R^{H,c}$, obeys the inequality*

$$\frac{R^{L,c} - R^{H,c}}{\rho\left(1 - C^*\right)} < 1. \tag{15}$$

The interpretation of Proposition 3 is that comparing a firm in regime L and a firm in regime H, the difference in interest rates, $R^{L,c} - R^{H,c}$, is smaller than the difference in the instantaneous expected loss upon default, $\rho\left(1 - C^*\right)$—a manifestation of the rents that we discussed above.

If firms are heterogeneous and each firm is charged a different value of $R_i^{H,c}$ and $R_i^{L,c}$, relation (15) implies

$$E_i \frac{\left(R_i^{L,c} - R_i^{H,c}\right)}{\rho\left(1 - C^*\right)} = \frac{E_i\left(R_i^{L,c}\right) - E_i\left(R_i^{H,c}\right)}{\rho\left(1 - C^*\right)} < 1, \tag{16}$$

where E_i is a cross-sectional expectation. Equation (16) can be written as

$$E_i\left(R_i^{L,c}\right) = E_i\left(R_i^{H,c}\right) + \beta\rho\left(1 - C^*\right), \text{ where } \beta < 1. \tag{17}$$

In other words, we should expect a beta coefficient less than 1 in a cross-sectional regression of R_i on the (instantaneous) expected capital loss in the case of default, which would be the marginal cost of the loan in a frictionless market.[15,16] We refer to this model prediction as the "limited pass-through" hypothesis and test it in Section 4.

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[15]In our stylized model, during the crisis regime, this expected loss is zero if the firm is in the high-profitability regime H and $\rho(1 - C^*)$ if the firm is in the low-profitability regime L.

[16]We also note that in the data, the relevant default probability is not just the instantaneous default probability, but rather the default probability over the duration of the loan. Therefore, the theoretical conclusions of our model should be understood as approximations for loans that are sufficiently short term.

A straightforward implication of the model is that $R^{L,c} - R^{H,c}$ is declining in the opportunity cost of funding, and increasing in π^L.

Proposition 4. *The partial derivative, $\frac{\partial(R^{L,c}-R^{H,c})}{\partial(\frac{D}{C})}$, is negative. The partial derivative, $\frac{\partial(R^{L,c}-R^{H,c})}{\partial\pi^L}$, is positive.*

Proposition 4 implies that when the severity of the crisis increases — either because collateral values C fall (and the opportunity cost of funding, $\frac{D}{C}$, increases), or because the profitability of firms in the L regime, π^L, declines — then the gap in the rates charged to $H-$ and $L-$ regime firms, $R^{L,c} - R^{H,c}$ declines. This is intuitive. A rise in the opportunity cost of funding allows more aggressive limit pricing of $H-$regime borrowers (higher $R^{H,c}$), while a lower profitability of $L-$regime firms (lower π^L) lowers the rate $R^{L,c}$ that these $L-$regime firms can afford to pay. Proposition 4 motivates the empirical analysis in Section 5.

An additional theoretical implication of the model is that pass-through is not only limited, but is also "asymmetric" in a sense that we explain next. In our model, competitive considerations only matter for H regime firms.[17] By contrast, in the L regime, the pricing of a loan is determined exclusively by a borrower's ability to pay ($R_i^{L,c} = \pi^L$)

To show the empirical implications of this asymmetry, we can extend the model to introduce borrower-specific regime switches in the parameters governing the cash-flow dynamics of each borrower (e.g., Markov regime shifts in p^L or p^H) that are independent of the cash-flow regime switches we have discussed so far. The goal of this extension is to allow within-borrower and within-profitability-regime variation in the interest rate of each borrower.

Now consider a borrower in the H regime and suppose the borrower becomes riskier (e.g., p^L increases unexpectedly). According to (13), this change will increase $R^{H,c}$.[18] It will also increase the probability of default of a loan that is extended over a discrete interval of time.[19] Therefore, fixing a firm that is in regime H, we should observe a positive within-firm, within-regime co-variation in the interest rate and the discrete-interval probability of default. By

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[17]The pricing of the loan in the H regime is determined by $V^{H,c} = \frac{D}{C}$, which ensures a borrower is not poached by a rival bank.

[18]Note the value function $V^{H,c} = \frac{D}{C}$ is irrespective of any parameters, and so the regime switches in the parameter p^L will only impact $R^{H,c}$, not the value functions $V^{H,c}, V^{L,c}$.

[19]Note that whereas the instantaneous probability of default is zero for a firm in the profitability regime H (as long as the economy remains in the crisis state), the probability of default over a discrete interval of time (e.g., t to $t+1$) is always positive and increasing in p^L. The reason is that the probability that the firm could go into regime L and then into default over the time-interval t to $t+1$ is positive.

contrast, if a firm is in the L regime, changes in p^L or p^H will change the discrete-interval probability of default but will leave interest rates unaffected because the interest rate is determined only by what the borrower can afford to pay ($R_i^{L,c} = \pi^L$). Accordingly, the covariance between interest rates and the discrete-interval probability of default for firms in the L-regime should be zero. This "asymmetric" pass-through implication is an additional feature of the model that we test in Section 6.

Before presenting our theoretical results, we briefly describe two model extensions that are mostly of theoretical interest, and therefore, we relegate them to the Appendix. Specifically, Appendix A.3.1 contains an extension of the model where banks face different discount rates, r. Appendix A.3.2 considers an extension whereby some lenders invest funds in safe assets during some "pre-crisis" state, with the intent of poaching H firms during the crisis and capturing some of the rents of the banks.

3 Regulatory Framework and Data

3.1 The Greek financial crisis

The global financial crisis of 2008 and the subsequent European sovereign crisis had a severe impact on the Greek economy. In just a few years, Greece lost over 25% of its GDP, and its unemployment rate reached 27%. Greek bond spreads rose to historic highs, de facto excluding the country from international markets. The recovery process was particularly prolonged and required three economic adjustment programs (MoUs), in 2010, 2012 and 2015. Figure 1 plots real GDP growth rates for Greece as well as Cyprus, Italy, Portugal, and Spain (CIPS) over our sample period. The graph shows that Greece did not experience a recovery from 2014 onwards, unlike the other economies.

The crisis had an acute impact on the banking sector, which has always played a central role in the Greek financial system.[20] The crisis exposed long-term weaknesses of the banking sector, including the over-exposure to Greek government bonds. The "private-sector involvement" (PSI) restructuring program and the "haircut" on Greek bonds in 2012 led to the first

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[20]See Haliassos, Hardouvelis, Tsoutsoura & Vayanos (2017) for a review.

recapitalization of the major Greek banks mainly with public funds. Two additional rounds of recapitalization were necessary in 2014 and—after capital controls were imposed—in 2015.

This setting motivates the two key assumptions of our model during the "crisis" period (which corresponds to the entirety of our sample), namely, (i) collapsing collateral values and (ii) limited access to international capital markets. For instance, the Bank of Greece reports a 30% decrease in commercial real-estate values from 2010 to 2014, a conservative proxy that banks use to track collateral values of corporate loans.[21] Furthermore, Greece remained practically excluded from international financial markets until 2017, and the Greek banking system became increasingly reliant on ECB and emergency liquidity assistance (ELA) funds.

3.2   Regulatory framework: The new loan pricing guidelines

Before the crisis, corporate loan managers used to base their pricing decisions on bank funding and operating costs, as well as an internal credit-risk assessment of the borrower. These managers, who typically maintain a portfolio of a limited number of firms, were responsible for negotiating with the borrowers and finalizing the terms of new loans, subject to approval by the upper-level management of the bank. Although bank funding costs and internal credit assessments were taken into consideration in setting the interest rate on a loan, there was no systematic, data-driven, and model-based determination of the marginal cost of a loan (the BE rate) in place, leaving significant room for discretion.

Following the PSI, which led to a considerable "haircut" on Greek bonds and the inevitable recapitalization of Greek banks in 2012, monitoring trustees required the development and use of uniform, data-driven, pricing models for credit products.[22] This request reflected growing concerns over subjective pricing and zombie-lending practices, not only in Greece but in a number of countries on the periphery of the Eurozone (e.g., Acharya, Imbierowicz, Steffen & Teichmann (2020); Acharya et al. (2019)).

In response to these mandates, each major systemic bank had to gradually develop its own

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[21]https://www.bankofgreece.gr/en/statistics/real-estate-market/residential-and-commercial-property-price-indices-and-other-short-term-indices

[22]Monitoring trustees refer to auditing companies, which work under the direction of the European Commission, the European Central Bank, and the International Monetary Fund, and audit all activities of Greek banks following the PSI.

pricing model, independently. However, all frameworks had to adhere to two requirements. First, they should be based on exogenous credit-risk assessments to ensure banks could not affect the underlying credit risk models. Second, the pricing models should be applied uniformly to all loans of the same class (in our case, the large corporate portfolio) with common parameters for non-firm-specific variables. Importantly, regulatory charges would no longer be computed directly at the level of the bank's entire portfolio, but rather at the individual loan level and then aggregated. The goal was to create transparency about the marginal contribution of each loan to the bank's regulatory capital charges.

The pricing model of the bank that we consider has a "fixed" and a "variable" (i.e., loan-specific) component. The fixed component includes the bank's funding and operating costs, which are common for all firms in our sample at a given point in time. The variable component is loan specific and depends on loan and borrower characteristics. Because the majority of loans in our sample are floating-rate products, interest-rate risk adjustments are negligible in the cross-section, and the main source of cross-sectional variation is due to credit risk.

Following contemporary banking practice, the credit-risk cost consists of the cost for "expected losses" and the cost for regulatory capital. The cost for expected losses is estimated based on the difference between the loan balance and the adjusted value of the collateral multiplied by a formulaically-derived default probability for the firm. This default probability is based on a credit model developed by an entity *outside the bank*. The cost of regulatory capital, which is related to "unexpected losses," is estimated using a credit-risk model in accordance with the Basel framework as defined in regulation EU 575/2013 (Capital Requirements Regulation), adjusted by a hurdle rate. All inputs are based on exogenous sources (i.e., risk assessments) and data (i.e., balance-sheet items) to prevent subjective assessments and manipulation of the pricing model (see Behn et al. (2022)).

The fixed and the variable components, described above, add up to the breakeven interest rate, which is the final output of the pricing model. The guidelines to the loan managers describe the BE interest rate as the lowest interest rate that does not render the loan loss-making—in effect, the marginal cost of the loan. Loan managers were free to offer rates higher than the BE rate to their borrowers. But if the actual rate was lower than the BE

rate, monitoring trustees required internal approval at the highest level, which stated the reason for the discount.

3.3 Data

Our data come from a large, Greek bank that, as all systemic banks in Greece, was recapitalized and had successfully passed strict stress tests of the EBA in Fall 2014.[23] Our analysis combines several proprietary datasets from the bank using coded identifiers at the borrower and account (i.e., loan) level. Our main sample comprises all loans extended to firms that belong to the "large corporate portfolio" of the bank (hereafter, large firms). The large corporate portfolio of the bank consists of firms above a certain size threshold. Our main sample consists of 1625 accounts and 150 borrowers. It includes some of the largest (top 5% in terms of assets and sales) and most established firms in Greece. Figure 2 plots the size distribution for the 150 firms in our sample and the universe of Greek firms covered by Amadeus van Dijk in 2014.[24] As is evident from the graph, our sample covers the largest firms in Greece. We focus on term loans and credit lines, and our main sample period is from January 2015 to June 2017 (see Figure A1).[25]

Our main dataset provides information on new loan contracts during our sample period. Every time a new loan is extended to a firm, we observe both the actual and the *breakeven* interest rate ("BE" rate). We also observe the values of the components of the BE rate as well as the variables used for the estimation of each component (i.e., credit score, collateral). Over the course of our sample, short-term loans commonly come up for renewal; thus, we typically observe several loan contracts per borrower.

As noted earlier, loans priced below the BE rate required special approval and a justification for the discount. In a separate file, we observe all the internal-approval decisions for loans priced below the BE rate, along with the provided explanations for the discount. These justifications are qualitative, but there is a discrete number of categories exist that

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[23]See https://www.eba.europa.eu/risk-analysis-and-data/eu-wide-stress-testing/2014.

[24]Amadeus Bureau van Dijk database is a comprehensive, pan-European database containing financial information on over 14 million public and private companies.

[25]In section 8.1, we also extend our dataset back to January 2013 to study loan pricing practices prior to the introduction of the new pricing guidelines.

each justification can fall into.

Finally, we complement the data with firm-level accounting information from firms' balance sheets and annual income statements.

3.4 Summary statistics

Table 1 reports summary statistics for our sample. Panel A focuses on loan-level variables and shows that the average actual interest rate and BE rate in our sample are 5.4% and 4.8%, respectively, implying an average markup (i.e., the difference between actual and BE rate) of 62 bps. Remarkable differences exist in the markups charged to different loans. At the 5th percentile, the markup is significantly negative (-3.57%), whereas it is very large at the top 95th percentile (4.46%). The histogram of markups in Figure 3 illustrates this large dispersion.

The average loan balance is 3.6 million euros, but with a substantial standard deviation (14.35). The average maturity is short (0.62 years) and its standard deviation is comparatively large ($\sigma = 1.51$). The short average maturity is to be expected, because short-term loans tend to be rolled over more frequently than long-term loans, thus making up a bigger fraction of the observations. In addition, because our dataset corresponds to a crisis period, the bank prefers the flexibility of short-term loans that get rolled over frequently. The majority of the loans are collateralized (85%).[26]

We present the summary statistics for borrower-level variables in Panel B of Table 1. The average borrower in our sample has operating returns on assets (OROA) of 4.6%, deposits of 19 million euros, total assets of 238 million euros, and debt ratio equal to 51%.

4 Limited "Pass-Through"

The first prediction of our theoretical analysis is the limited "pass-through" hypothesis (Proposition 3), which states that a less than a one-for-one "pass-through" exists from the

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[26]Table A2 provide summary statistics for loans with positive and negative markups, and Tables A3 and A4 provide summary statistics for term loans and credit line products separately.

BE rate to the actual rate.[27]

Figure 4 plots the relation between BE and actual rates for all loans initiated after the new pricing guidelines go into effect. The figure provides a first illustration of cross-subsidization in our sample. An observation above (below) the 45° line indicates a loan priced above (below) its breakeven rate.[28] The graph shows that the large majority of the observations are on or above the 45° line, consistent with the pricing guidelines provided to the loan managers. However, a non-trivial number of loans receive actual rates below the BE rate, even though such loans are scrutinized and require internal approval. Specifically, 14.6% of loans in our sample are extended at actual rates at least 100 bps below the BE rate with an average markup of -4.02%. Furthermore, the slope of the regression line relating actual and BE rates is substantially less than 1, implying that the markup is a declining function of the breakeven rate.

To gauge the statistical significance of the pattern illustrated in Figure 4 and to control for covariates, we estimate the following OLS specification:

$$Actual\ Rate_{imt} = \alpha_t + \alpha_s + \beta\ Breakeven\ Rate_{imt} + X_{it}\delta + X_m\eta + \varepsilon_{imt}, \tag{18}$$

where $Actual\ Rate_{imt}$ corresponds to the interest rate issued to loan m of borrower i in month t, α_t are time fixed effects, α_s are industry fixed effects, X_{it} are time-varying borrower controls, and X_m are loan controls. The coefficient β of $Breakeven\ Rate$ is our main estimate of interest and represents the cross-sectional pass-through of the BE rate. Specifically, values below one signify that each percentage increase in the BE rate results in a less than one-for-one pass-through to the actual interest rate.

We report our baseline estimates of equation (18) in Table 2. The estimated β coefficient in column (1) is roughly 0.3, meaning that, after the implementation of the new pricing guidelines, a 1% increase in the BE rate results in a 30 bps increase in the actual interest rate. In column (2), we show that this relationship is unchanged after including time (quarter)

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[27]To connect our theoretical model to our empirical specification here, note that equation (17) refers to the marginal cost of the loan in a frictionless market, where the expected loss is zero if the firm is in regime H.

[28]Note that some observations have the same x-value, because the borrower's credit rating, which is an input into the pricing equation, takes discrete values.

fixed effects. Columns (3) to (5) show that the estimate of cross-sectional pass-through is unaffected when including observable firm-level characteristics, loan-level characteristics or industry fixed effects. Including these covariates leaves the estimate and the standard errors of the BE rate essentially unchanged. In column (6), the pass-through from BE to actual interest rate is significantly reduced once we augment equation (18) with firm-fixed effects. We provide a more in-depth discussion of this finding in Section 6.

In Table 3, we augment equation (18) with a control for the borrower's lagged interest rate. This lag term is calculated as the average interest rate of the borrower's loans in the most recent previous month, and thus plausibly reflects up-to-date information that may not be captured by the borrower-level controls. The table shows that even after controlling for the lagged borrower-specific interest rate, our conclusions remain unchanged. In our baseline specifications of columns (1) to (5), the coefficient for the BE interest rate is statistically significant and ranges between 0.18 and 0.20. The observable firm-level and loan-level characteristics do not exhibit significant explanatory power for the actual interest rate. However, the coefficient for the lag term of the borrower interest rate is statistically significant and ranges between 0.54 and 0.58, which may be either due to inertia in the interest-rate setting or to the fact that the lagged interest rate reflects more up-to-date information than borrower-level controls.[29]

It is important to emphasize that any attempt to manipulate the model or the firms' strategic reporting choices would work against—not in favor of—the results on the partial pass-through we document. In other words, if loan managers were able to affect the model outcomes or to provide guidance to firms on how to avoid a higher BE rate (e.g., through window dressing), then we would observe a lower level of cross-subsidization among borrowers. The reason is that loan managers have an incentive to avoid extending loans below the BE rate (observations below the 45° line in Figure 4) that would attract scrutiny. Thus, in the presence of manipulation practices, our results on the limited pass-through would *understate*—rather than overstate—actual cross-subsidization in our setting.

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[29]We find similar results for all the tests in this section when we separate the sample into term loans and credit lines (see Appendix Tables A5 and A6).

5 Pass-Through and the Severity of the Crisis

Our sample covers the dramatic events of May-July 2015, which brought Greece to the brink of soverign default.[30] This period presents us with an opportunity to examine how a deepening (abatement) of the crisis reduces (increases) the pass-through of the BE rate to the actual rate.

The episode we exploit unfolded between May-July 2015. The second MoU between Greece and its creditors was coming to its conclusion in late 2014. The newly-elected party of Syriza (January 2015), which was elected with an anti-austerity agenda, restarted negotiations with Greece's official creditors. This action led the creditors to withhold the last remaining tranche of the second memorandum, which was needed to prevent sovereign default (default was projected around June 30 without the financial help of the creditors). In February 20, 2015, the Eurogroup issued a promising statement that Greece and its official creditors had agreed to conclude technical negotiations by April 30. The hopes of an agreement were shattered on May 1 when the two parties reached an impasse in the negotiations. During May and June 2015, the Greek financial crisis reaches its peak with the prospect of sovereign default more likely than ever. Last-minute negotiations failed. On June 27, 2015, Prime Minister Tsipras called for a snap referendum (on July 5, 2015) on the agreement put forth by the creditors. Despite campaigning for a "No" vote to the agreement, and decisively winning, Tsipras surprisingly returned to the negotiating table, and on July 13, signed a new, third memorandum with terms essentially identical to the memorandum that the Greek people had rejected a week earlier. This development prevented sovereign default, allowed banks to re-open (banks remained essentially closed in the first two weeks of July), and marked a major turning point in the Greek financial crisis, because it illustrated that no political party was inclined to face the political consequences of default.

The events of May-July 2015 allow us to examine how the pass-through of breakeven rates to actual rates changes (both across and within borrowers) as the country unexpectedly

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[30]In a recent interview. Christine Lagarde, then head of the IMF, described the events of that time as follows "...The second time, when the threat was much more noticeable and much more alarming, was in July 2015. So we had two threats of Grexit, but 2015 was the most palpable and without the decisive reaction of some European leaders this would have happened." Source: Newspaper Kathimerini, 05.11.2023, Interview with Alexis Papahellas.

changes its policy trajectory on July 13, 2015. As an illustration, Figure 5 shows a time series of cross-sectional pass-through coefficients (β_t along with its confidence bands) estimated by regressing actual on breakeven rates

$$Actual\ Rate_{imt} = \beta_t\ Breakeven\ Rate_{imt} + \varepsilon_{imt}, \tag{19}$$

where i is a borrower, m is a loan, and t is either a week (left plot of Panel A) or a month (right plotof Panel A). The figure shows that when May 1, 2015, arrives, it becomes apparent that the original optimism of an agreement was misplaced, and the pass-through coefficient becomes essentially zero. It remains zero until mid-July. In the week immediately following the agreement on the third memorandum (July 13), the pass-through coefficient exhibits a noticeable jump to levels above 0.5.

Table 4 provides formal statistical evidence. We test whether the pass-through coefficient during the "crisis abatement" period (the six months after the signing of the third memorandum, i.e., July through December, 2015) is higher than the pass-through coefficient during the "deep crisis" period (May and June, 2015). Specifically, we focus on observations encompassing the "deep crisis" and its abatement (May through December 2015) and run the regression

$$Actual\ Rate_{imt} = \alpha_t + \alpha_i + \beta\ Breakeven\ Rate_{imt} + \delta D_{\mathrm{post}} \times Breakeven\ Rate_{imt} + \varepsilon_{imt}, \tag{20}$$

where δ is the coefficient on the BE rate interacted with an indicator (D_{post}) that takes the value of 1 if the loan was signed after the third memorandum (July, 13, 2015). The various columns in the table show results as we include (progressively) time-fixed effects, industry-fixed effects, and borrower-fixed effects. (The inclusion of borrower-fixed effects is possible, because many borrowers sign multiple loan contracts with the bank within the year.[31]) The table confirms that the jump in the pass-through coefficient from the deep crisis period (m5-m6) to the crisis abatement period (m7-m12) is economically and statistically significant for

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[31]Put differently, the inclusion of borrower-fixed effects implies that a given high- (low-) BE-rate borrower is more likely to experience a positive (negative) change in the actual rates that she receives on loans signed in the post-memorandum months compared to the pre-memorandum months.

any combination of fixed effects. If we interpret the signing of the third memorandum as an abatement of the crisis, then the results of this section support the prediction of Proposition 4.

6   Asymmetric Pass-Through at the Borrower Level

The previous section examined how borrowers with different breakeven rates were impacted by a temporary intensification and subsequent abatement of the crisis (Proposition 4).

In this section, we examine more closely how borrower-specific variation in the breakeven rate affects the borrower's interest rate. This borrower-specific variation allows us to test some specific model predictions that we discussed at the conclusion of Section 2.3: according to our model, once a firm is in the low-profitability regime, the bank extracts all free cash flow and the firm's probability of default becomes irrelevant; in this regime, the only determinant of the actual interest rate is the borrower's *ability* to pay. By contrast, if the same firm finds itself in the high-profitability regime, its interest rate is determined by a limit-pricing condition, and thus, the actual interest rate is positively related to the firm's default probability.

To illustrate this feature of the model, we re-estimate equation (18) including both time and firm fixed effects, but we split the sample into two subsamples: the first (second) subsample includes firms whose initial BE rate at the introduction of new pricing guidelines is below (above) the median. Phrased differently, the first (second) subsample contains borrowers who are likely to be in the high- (low-) profitability regime in the sense of our theoretical model.

Table 5 reports an interesting asymmetry. Columns 3 and 4 show that firms with high initial BE rates (riskier borrowers) exhibit essentially no pass-through after controlling for time and firm fixed effects. By contrast, firms with a below-median BE rate (safer borrowers) experience pass-through values around 0.43, which are both economically and statistically significant. This finding is consistent with the view that after a certain value of the BE rate, interest rates are dictated by factors such as the borrower's ability to pay, rather than the

breakeven cost of the loan, as the theoretical model predicts.[32]

The near-zero pass through for riskier borrowers is consistent with the view that (a) the bank's ability to charge high interest rates is constrained by the borrower's ability to pay, and (b) this constraint is more likely to be binding for firms that start out with high initial BE rates. Because this constraint is binding, incremental variations to the firm's BE rate are irrelevant for the determination of their actual interest rate.

7 Loans with Negative Markups

Before discussing some potential alternative interpretations of our main finding of an imperfect pass-through, in this section, we focus on loans with negative markups. As we discussed in the introduction, a large literature investigates the identification and the properties of below-breakeven rate loans ("zombie lending"). Because the breakeven rate is typically not directly observable, the literature relies on indirect identification approaches, including (a) focusing on loans with below-prime interest-rate loans and (or in conjunction with) (b) indicators of distress, such as a low interest coverage ratio. In this section, we apply these criteria and examine whether they identify the subsidized loans (which our sample allows us to observe directly). We also investigate in closer detail the qualitative reasons the loan managers provide for the negative markups.

7.1 Identification of negative-markup loans

Figure 8 plots all loans that (i) feature actual rates below the BE rate (i.e., observations below the 45° line, (ii) loans with an actual rate below the the rate of highest-credit-rating firms (prime rate), and (iii) loans to firms with interest coverage ratios (ICRs) less than 1 for the past two years. The observations satisfying the first criterion are the subsidized loans in our sample, whereas definitions (ii) and (iii) correspond to popular methods for identifying zombie lending in the literature. We make the following observations. First, several firms with an ICR less (greater) than 1 have loans that are above (below) the 45° line. In that

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[32]We note that this near-zero pass-through for above-median BE rate borrowers is the reason why the pass-through coefficient for the entire sample becomes very small once we control for both time and firm fixed effects (last column of Table 2).

sense, criterion (iii) is a somewhat informative, but still noisy indicator of subsidization, resulting in both false positives and false negatives. Second, all loans with an actual rate below the prime rate are below the 45° line. Thus, criterion (ii) does identify loans with actual rates below the BE rate; however, it is overly conservative and it fails to identify the vast majority of subsidized loans. More importantly, the loans identified by this criterion are not representative of the population of subsidized loans, because their BE rates tend to be quite low compared with all the loans with negative markups (below the 45° line).

The main conclusion of Figure 8 is that the ability to observe the loans with negative markups directly, rather than indirectly, is valuable and not redundant. Indirect approaches have some information content, but are noisy and may be subject to sample selection issues. As an additional illustration of this statement, in Appendix A.2 (Tables A7 – A10), we show that some of the characteristics that are found to matter in the zombie-lending literature don't seem to affect the pass-through coefficient in our dataset. (For instance, Tables A7 and A8 show that the pass-through coefficient does not differ across loans in different size-bins and Table A9 also shows that the breakeven coefficient does not depend on whether the borrowers are in "concentrated" industries, that is, industries that make up a large part of the bank's loan portfolio.)

7.2 Justifications for below-breakeven-rate loans

The new pricing guidelines required that loan managers receive a separate approval in any situation where the interest rate charged on a loan is below the BE rate (see section 3.2). In such situations, the loan managers need to provide a qualitative explanation that can fall into a *discrete set* of justifications, which we label A, B, and C.[33]

An interesting pattern in the data is that the magnitude of the BE rate is a very good predictor of the provided qualitative justification. Figure 7 provides a visual illustration between discount justification, the BE rate, and the actual interest rate. The figure shows that the discount reason is directly related to the breakeven rate. Specifically, the third discount reason (orange-colored observations) is the most commonly offered explanation for loans with high BE rates, which receive the highest "discount." Similarly, loans with a BE

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[33]Because of our data agreement, we cannot provide more details on the text of these justifications.

rate in the middle range are generally approved for a discount by citing the second reason (blue), and discounts for loans with the comparatively lower BE rates and lower discounts are mostly granted after citing the first reason (green). The corresponding discount amount for this last group of loans is also generally small.

To better understand the implications of this figure, we isolate observations with a negative markup and estimate the regression

$$Justification = \alpha + \underset{(0.022)}{0.074}\, Breakeven\, Rate - \underset{(0.036)}{0.012}\, NegMarkup + QuarterFE + \varepsilon, \quad (21)$$

where $Justification$ takes values $\{1,2,3\}$, and $NegMarkup$ refers to (non-positive) differences between the actual and the BE rate. The numbers in parentheses denote (robust) standard errors.

The regression shows that the magnitude of the BE rate is a statistically significant predictor of the provided qualitative reason, whereas the magnitude of the discount is not. One implication of regression (21) is that the qualitative justifications cannot be just a reflection of the length and strength of the relation between the bank and the borrower, because these variables are not inputs to the breakeven rate.

8 Discussion and Robustness

8.1 Introduction of the new pricing guidelines

In this section, we address the question of whether the limited pass-through is just the result of loan managers' reluctance to heed the new pricing guidelines. In particular, could loan managers simply have ignored the breakeven rate and treated it as a sideshow?

We start by showing that the adoption of the new pricing guidelines—in the beginning of 2015—had a material impact on loan-pricing decisions. To illustrate the effects of the enactment of the new pricing guidelines, we sort borrowers into three terciles (low, medium, high) according to the *initial* breakeven interest rate provided by the new pricing model, that is, their first-ever-assigned BE interest rate. We focus on borrowers who sign a new loan contract with the bank both in the year before and after the enactment of the new

pricing guidelines. In Figure 6, we report the distribution of the *change* in each borrower's actual interest rate (from 2014 to 2015) by initial-BE-rate group. We find these distributions indeed appear different for the three groups. The borrowers in the low-BE-rate bin receive a favorable adjustment to their interest rate (1.08% decrease on average), whereas the high-BE-rate borrowers receive an unfavorable adjustment (1.86% increase on average). On average, the medium-BE-rate borrowers experience no interest-rate adjustment. We further find that the three groups' distributions are statistically significantly different according to (pairwise) Kolmogorov-Smirnov tests.

To formally test these findings, we perform a regression analysis to test the relationship between a borrower's initial BE rate and the change in their actual interest rate on new loans.[34] Specifically, we estimate the following specification:

$$\Delta Actual\ Rate_{i,2015} = \alpha_s + \beta(Breakeven_{i,2015} - Actual\ Rate_{i,2014}) + \delta\Delta X_{i,2015} + \varepsilon_i, \quad (22)$$

where for borrower i, $Actual\ Rate_{i,t}$ is the average interest rate for new loans in year t, $\Delta Actual\ Rate_{i,2015}$ is the difference between the average interest rate in years 2015 and 2014, and $Breakeven_{i,2015}$ is the average BE rate in 2015, α_s are industry fixed effects, and $\Delta X_{i,2015}$ are first differences in borrower controls.

Intuitively, the coefficient of interest β captures how many basis points the actual rate of the borrower moves after the introduction of the pricing guidelines, for a 1 bps difference between the initial BE rate prescribed in 2015 and the actual rate in 2014. We also report results for a similar specification, using an adjustment model with "inertia":[35]

$$Actual\ Rate_{i,2015} = \alpha_s + \beta Breakeven_{i,2015} + \rho Actual\ Rate_{i,2014} + X_{i,2015}\delta + \varepsilon_i. \quad (23)$$

Table 6 presents the results of equations (22) in Panel A and (23) in Panel B. The table shows that the introduction of the new pricing model has a significant effect on the bank's pricing policies. The estimated β in column (1) of Panel A is 0.4, implying that for every

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[34]Similar to Figure 6, the sample consists of borrowers who sign a new loan contract with the bank both in the years pre- and post-guideline introduction.

[35]Note that specification (23) nests (22) as a special case when $\rho = 1 - \beta$.

1% discrepancy between the initial BE rate and the prior year's actual rate, the interest rate charged to the borrower rises by 40 bps. This result is both economically and statistically significant. Columns (2) and (3) further show that the result is similar in magnitude when we add borrower-level characteristics or industry-fixed effects. In Panel B, the β estimates of equation (23) remain essentially unchanged when we include a control for the actual interest rate in the year 2014 (i.e., before the enactment of the new pricing guidelines).

As an additional illustration of how the introduction of the new pricing guidelines changed the bank's pricing behavior, we perform the following exercise: using the borrower credit rating and the formulas used to compute the BE rate according to the bank's model, we can compute what the BE rate would have been for each borrower for the years prior to the introduction of the new pricing guidelines. Of course, this information was not available to loan managers at the time. Table 7 and Figure A2 show that the (ex-post calculated) BE rate plays essentially no role in loan-pricing decisions prior to the enactment of the new pricing guidelines, but plays a dominant role thereafter.

Table 7 formalizes the visual impression of Figure A2 in a regression specification that includes the BE rate, borrower and loan controls as well as board-of-director characteristics of the firms in our sample, which are described in the Appendix (Table A1). These board characteristics reflect political and media affiliations of board members, and tightly-held family firms (which would indicate a higher likelihood of personal connections). By including these board characteristics, we want to show that the introduction of a transparent, loan-level breakeven rate had a profound effect on the pricing behavior of the bank; In particular, it helped mitigate the influence of non-economic factors in loan pricing.

Table 7 shows which variables matter for actual loan rates prior to the enactment of the new pricing guidelines and thereafter. Because we have several variables pertaining to board characteristics, we also run a lasso regression to determine which variables have explanatory power before and after the enactment. Column (1) of Table 7 shows that the (ex-post calculated) BE rate cannot explain the actual interest rate during the pre-guideline period. Meanwhile, many board-characteristic variables (e.g., having the firm founder or a member with political affiliations on the board) are statistically significant for explaining the actual interest rate. Furthermore, column (2) shows that most of the board-characteristic

variables are included in the restrictive set of covariates selected by the lasso regression. Columns (3) and (4) show a drastic change after the enactment of the new pricing guidelines. Specifically, column (3) shows that the breakeven rate is one of only two variables with statistical significance in the full-covariate OLS specification. Additionally, the BE rate is the only variable selected by the Lasso regression in column (4)

In summary, our analysis in this section shows that the introduction of the new pricing guidelines was not just a side show; it changed materially the interest rates faced by borrowers with different initial breakeven rates. It also achieved the goal of mitigating non-economic influences on loan pricing, by facing loan managers with a clear and transparent measure of the marginal cost of each loan.

8.2   Superior information and future ratings changes

One possible interpretation of our results is that managers have superior information about a borrower and view the breakeven rate as a noisy measure of the firm's future prospects. For example, loan managers may choose to ignore an increase in the BE rate if they feel it presents a temporary worsening of the firm's prospects, which will revert in the future. A testable implication of this view, similar in spirit to Chiappori & Salanie (2000), is that when loan managers charge an interest rate below the BE rate, this decision should predict an improvement in the firm's future creditworthiness.

To test this alternative hypothesis, we use the borrower "rating," which is based on a credit model developed by an entity outside the bank, as a dependent variable. The borrower "rating" has a one-to-one correspondence with the borrower's probability of default, with higher ratings numbers indicating a higher probability of default. The rating is a key input for the determination of the breakeven rate. The advantage of using the borrower rating is that this quantity is always available and updated frequently for each borrower, irrespective of whether the borrower initiates a new loan contract in a given month. More importantly, our available data for this quantity extend well beyond the our sample of breakeven rates. Therefore, we can test if current markups can predict ratings changes for horizons up to five

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years. We run the following regression:

$$Rating_{i,t+h} = \alpha_t + \alpha_s + \phi\, Markup_{i,t} + \theta\, Rating_{i,t} + \varepsilon_{i,t}, \tag{24}$$

where $Rating_{i,t+h}$ corresponds to the rating of borrower i in month $t + h$, and $Markup_{i,t}$ is borrower's i difference between the actual minus the BE rate in month t.[36] We include time fixed effects, α_t, industry fixed effects, α_s, and include a control for the credit rating, $Rating_{i,t}$, of borrower i in month t.

Table 8 presents the estimates of equation (24) for horizons, h, extending up to 60 months. Panel A shows that, controlling for a borrower's current rating, the coefficient ϕ in (24) is negatively signed for all horizons (and almost always insignificant.[37]) The negative (and insignificant) sign in these regression is not consistent with the hypothesis that managers have foresight: if the limited pass-through is the result of the loan manager's superior knowledge of the future prospects of the firm, then a high (low) markup should predict a future increase (decline) in the probability of default, which would imply a positive, not negative, ϕ coefficient. (Note that higher credit rating values are coded to indicate an increase in a borrower's credit risk.) The second and third panel in Table 8 present the evidence separately for negative and positive markup borrowers. Once again, the coefficient on the markup (i.e., the difference between actual and breakeven rate) is always insignificant at the 5% level.

This inability of the markup to predict subsequent changes in a borrower's rating is consistent with the simple view that we took in our symmetric-information theoretical model, whereby the regime transitions that determine the firm's profitability and its probability of default are simple Markov processes. Therefore, the markup has no further predictive ability, after controlling for the current borrower rating.

In the Appendix we also test if future breakeven rates are better predicted by current breakeven rates, or by current actual interest rates. This test is motivated by models of "sluggish" price adjustment, which imply that current prices reflect the expectation of future

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[36]For borrowers with multiple newly initiated loans in the same month, we compute the average difference across these loans.

[37]The only exception is $h = 60$. The t-statistic for that horizon is on the borderline of significance at the 5% level.

marginal costs rather than current marginal costs.[38] According to this view, the current interest rate a borrower faces would be the conditional expectation of the average future breakeven rate; therefore, the current interest rate should be a better predictor of future breakeven rates than the current breakeven rate, especially if loan managers possess superior information. However, we find no such evidence in the data.[39]

8.3   Isolating the regulatory cost

Throughout the paper, we have been interpreting the breakeven rate as a "marginal cost" to the bank. In determining this BE rate, the pricing department of the bank sums up (a) its funding and operational cost, (b) the loan's probability of default times the expected loss upon default, and (c) the regulatory charge for each loan.[40] Whereas the first component is not borrower-dependent, the other two are. One possible explanation for our results is that the loan managers adopt a narrow view of the marginal cost of the loan and treat only the regulatory charge as the marginal cost of each loan, because —at least in the short run—only this component directly and unambiguously affects bank profits.

To the best of our understanding, loan managers are not provided with the decomposition of the total BE rate into its components, and their directions are to not extend loans below the BE rate. However, with experience and informal communication within the bank, the loan managers may come to know, or form an educated guess of, the regulatory charge. Assuming they consider only this component as the relevant marginal cost of the loan, we should expect to see a one-for-one pass-through of the regulatory charge, but not necessarily the overall breakeven rate.

Testing this hypothesis is straightforward, because we observe the decomposition of the the BE rate into its components. Specifically, we include the regulatory charge as a separate regressor alongside the BE rate. Table 9 shows that the coefficient and statistical significance of the breakeven rate remains essentially unchanged. The coefficient on the regulatory charge is small and statistically insignificant. Therefore, our results are unlikely to be driven by

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[38]This feature of optimal price-setting is the key building block of the New Keynesian Phillips curve.

[39]An obvious caveat is that the short time-series dimension of our dataset limits the horizon for this test to no more than two years.

[40]This latter part is referred to as the "unexpected loss" of the loan, and adheres to Basel guidelines.

loan managers adopting a more narrow view of the marginal cost of each loan.

8.4   Borrower "stickiness"

One of the implications of the theoretical model is that high-profitability borrowers are not poached by competitors, and loans in the low-profitability regime are not liquidated by the bank during the crisis period. Even though the bank earns rents from its loans to the strong borrowers, and in effect subsidizing the loans to its weak borrowers, in equilibrium, all the borrowers keep renewing their loans, irrespective of how their profitability conditions change.

Consistent with this prediction of the model, we do not find evidence that the frequency with which borrowers open new loans in the post-period is related to their markup. Figure A3 illustrates that no obvious relation exists between the frequency of new loan contracts and the magnitude of the markup. To test this visual observation more formally, we have repeated our main regressions using only the top-40 most frequent borrowers, and our results remain essentially the same. Furthermore, focusing on firms that have a loan in the year before and after the introduction of the new guidelines, we do not find that the initial rate adjustment (or the initial markup) has significant predictive power for either the probability of entering a new loan, or the magnitude of the loan balances in the post-guideline period (Table A12).

9   Conclusion

We exploit a regulatory reform mandating that Greek banks adopt objective, data-driven approaches for the computation of the cost of each loan (the "breakeven" rate). By observing each loan's BE rate, we obtain a direct measure of the markup charged on each loan, thus sidestepping the notorious difficulties of inferring this "markup."

We document that higher-rated borrowers are charged positive markups, whereas lower-rated borrowers are charged low and in some cases negative markups, despite the clear instructions to managers to avoid below-BE-rate loans. Thus, we can provide *direct* cross-sectional evidence of a de facto cross-sectional subsidization of riskier by safer borrowers. A unique aspect of this finding is that since we can observe the BE rate, we know that

the cross-subsidization of the weaker borrowers is conditional on the bank's information set: the bank knowingly extends below-BE-rate loans to some of its borrowers, suggesting that the cross-subsidization is deliberate, and not just the result of unintentional "pooling" of heterogeneous-quality loans.

Using the dramatic events surrounding the snap referendum of July 2015, and the surprising policy reversal that followed, we show that an aggregate tightening of financial conditions leads to a weaker pass-through of BE rates to actual rates, whereas an abatement of the crisis strengthens the pass-through.

Focusing on the pass-through of borrower-level variations of BE rates to actual rates, we document an interesting asymmetry. Changes in BE rates at the borrower level are passed through more strongly to higher-rated than to lower-rated borrowers. Our interpretation is that for low-rated borrowers, the ability of the borrower to pay (rather than the BE rate) is the primary issue behind the pricing decision.

We rationalize our main findings through the lens of a theoretical model that predicts borrower cross-subsidization during a lending crisis. According to this model, depressed collateral values lead to positive option values for maintaining below-marginal-cost loans in the lender's portfolio. This feature can justify why weaker borrowers receive negative markups and avoid liquidation. Additionally, limited access to capital markets results in impaired bank competition, which can explain why charging positive markups to stronger borrowers is sustainable during a crisis.

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Figure 1: Greek GDP growth and CIPS GDP growth

Greek GDP growth (constant prices, seasonally adjusted) vs. weighted-average GDP growth of CIPS (Cyprus, Italy, Portugal, Spain). Source: IMF.
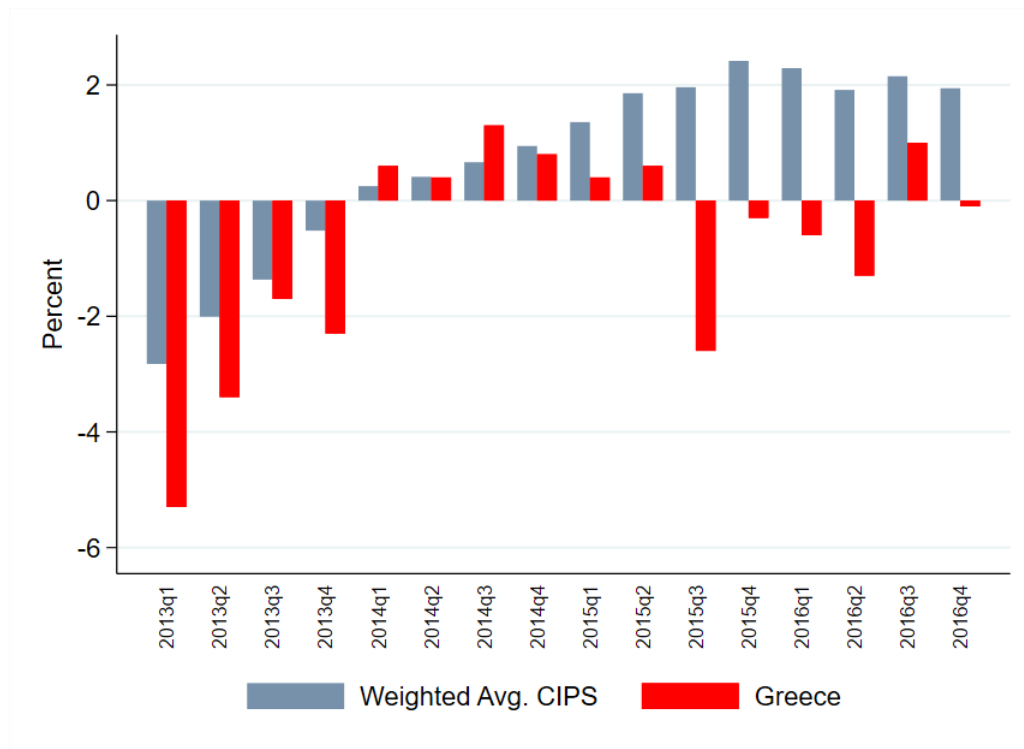
Figure 2: Sample distribution of log(Assets) vs. all Greek firms

This figure reports the distribution of log(Assets) for the 150 sample firms (red) and all 23,835 Greek firms in the 2014 Amadeus data (blue).
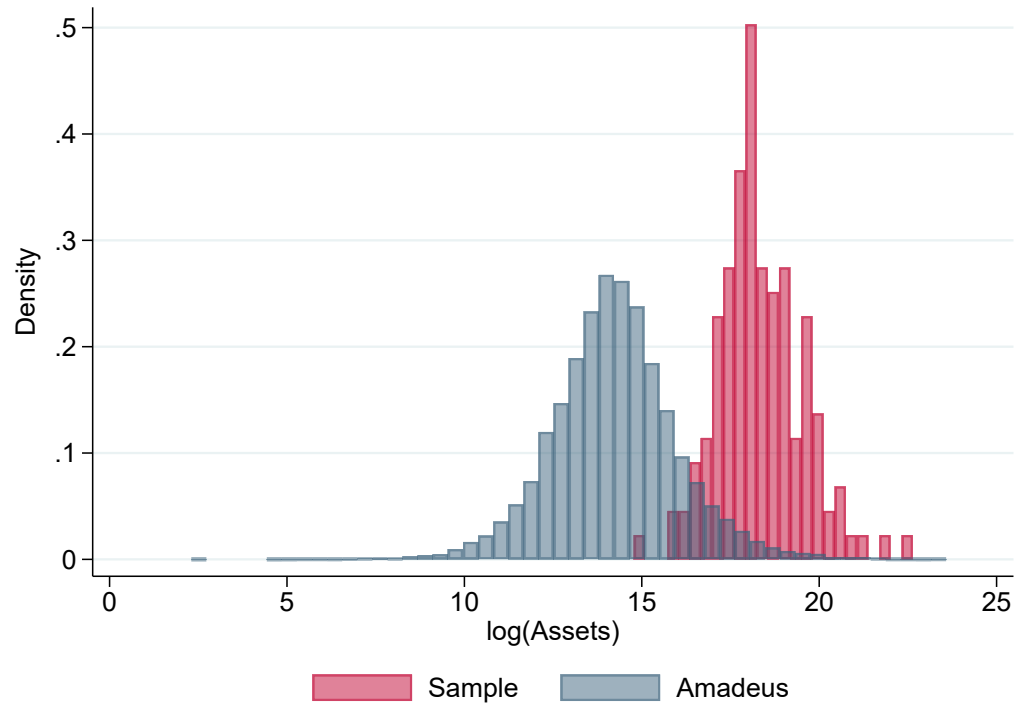
Figure 3: Histogram of markups

Histogram of the distribution of markups, defined as the difference between actual and breakeven rates.
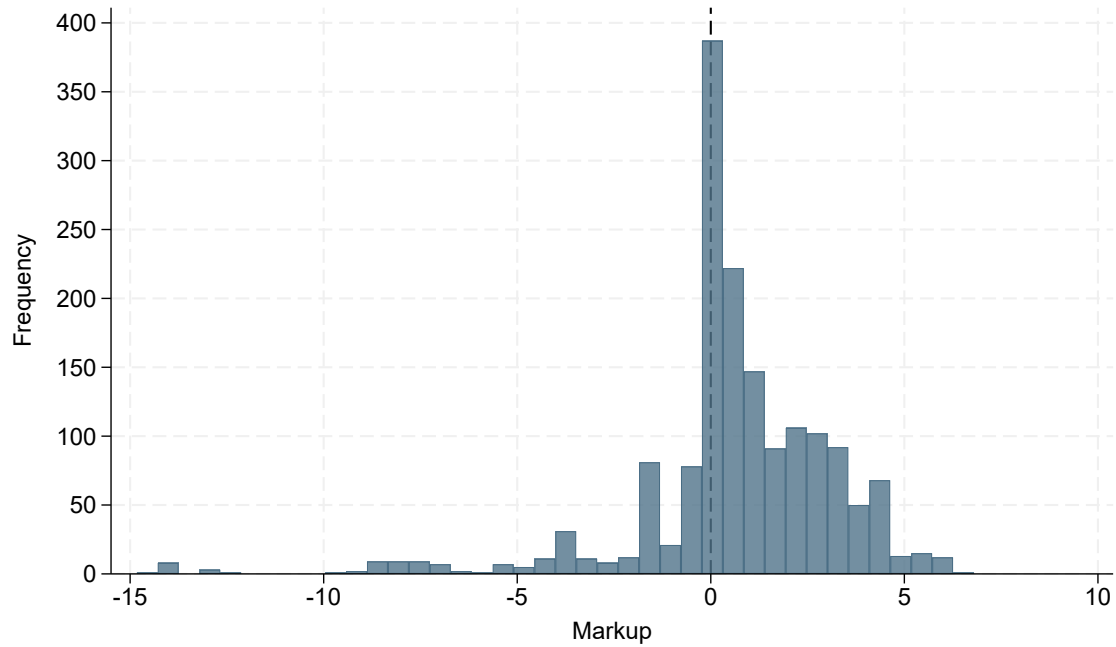
Figure 4: Actual rate and breakeven rate

This figure presents the scatter plot of actual and breakeven interest rates for new loans from 2015 to June 2017. The red dashed line corresponds to the 45° line. The blue solid line notes the OLS fitted line. The size of the circle corresponds to the relative size of the account. Black circles correspond to term loans, and brown circles correspond to credit lines.
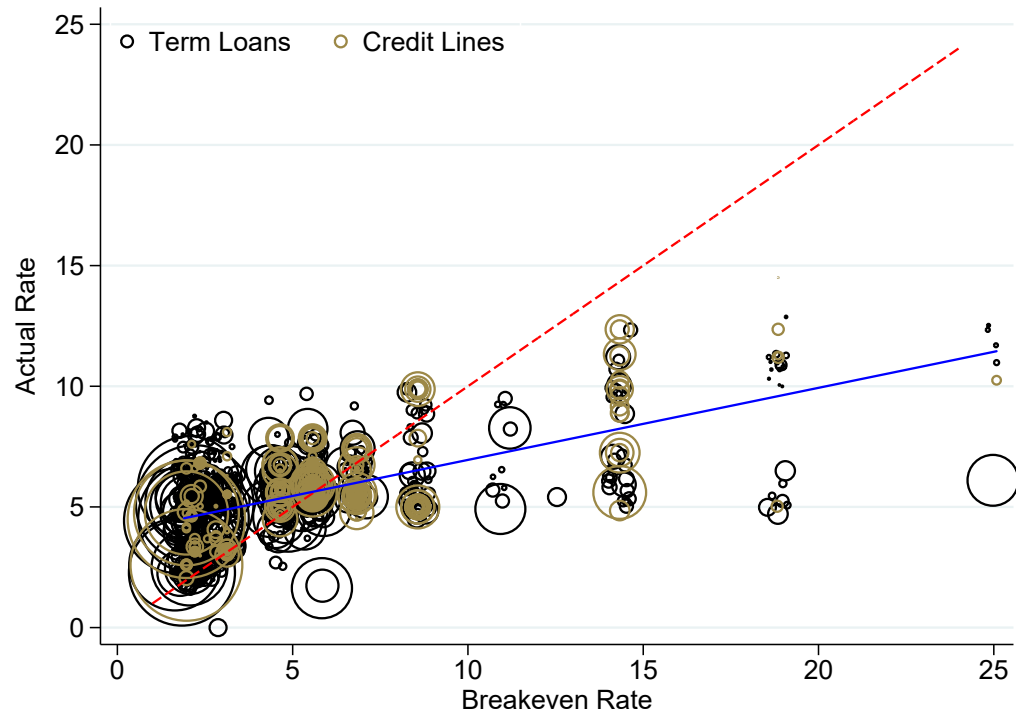
Figure 5: Time-series of pass-through coefficients around the peak of the crisis

Time series of Pass-through coefficients from equation (19). Left Plot: Weekly pass-through coefficient (with confidence bands), Right Plot: Monthly pass-through coefficient (with confidence bands centered at the point estimate). The three vertical dashed lines in the two figures correspond to (i) May 1 (the expiration of the deadline to conclude the technical negotiations between Greece and its official creditors), (ii) June 26 (the announcement of a snap referendum), (iii) July 13 (the surprising agreement on a third memorandum). We refer to the period between the first two dotted lines as the "deep crisis" period, and the period after the third dotted line as the "crisis abatement" period.
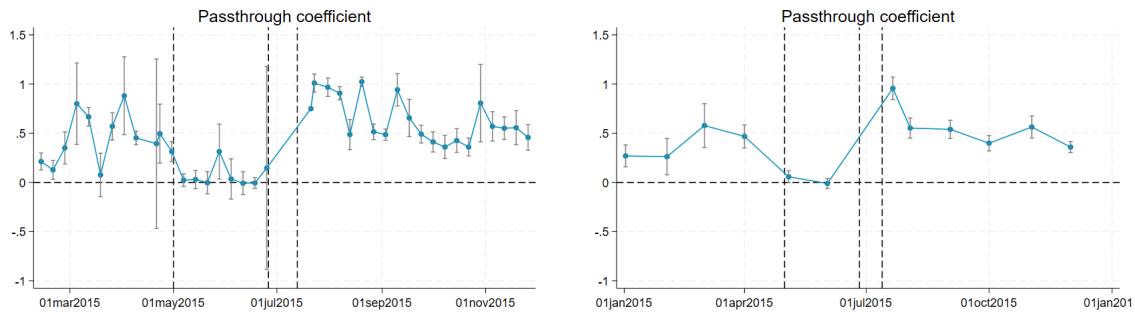
Figure 6: Actual rate changes by initial BE rate

These figures report the distribution of actual rate changes by initial BE rate. The sample is divided into three terciles, according to the initially reported BE rate of each corporate borrower in 2015. Each plot shows a histogram of the changes to a borrower's actual rates from 2014 to 2015 for the corresponding tercile of initial BE rate. The red, vertical dashed lines represent the mean of each distribution, and the vertical, gray dashed lines denote the one-standard-deviation range around the mean.
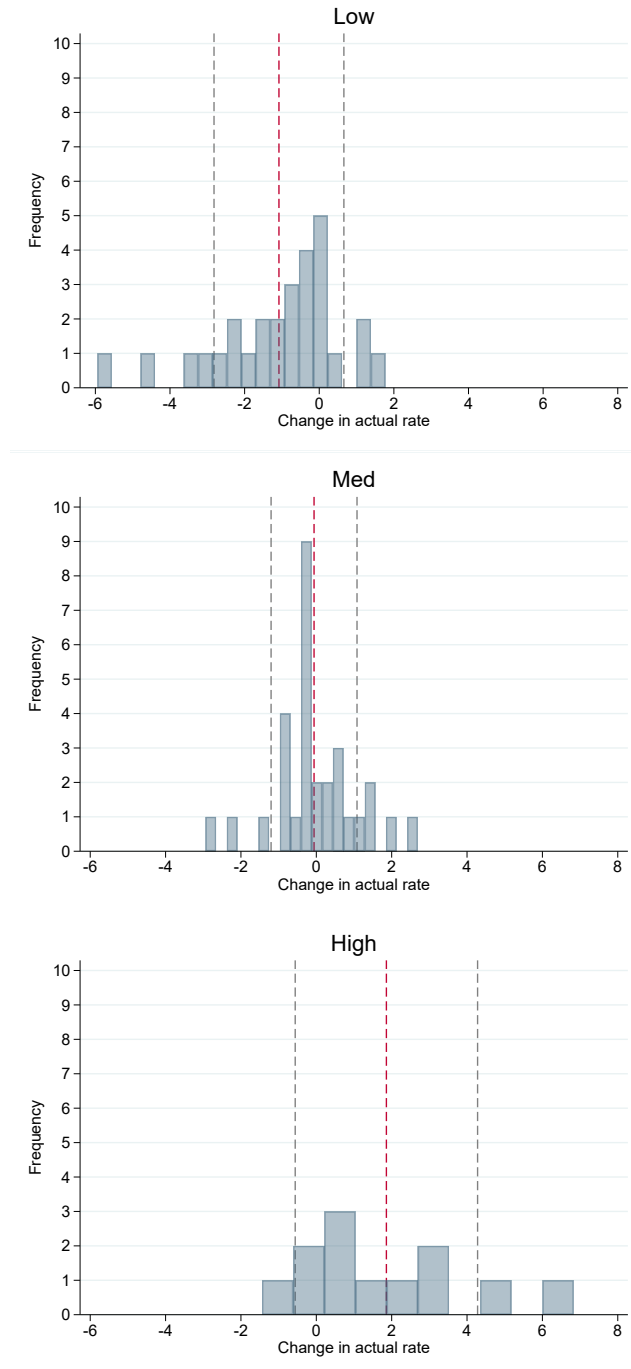
Figure 7: Reasons provided for below-BE-rate loans

Actual and breakeven rates of below-BE-rate loans, grouped by the cited discount reason. The red dashed line corresponds to the 45° line.
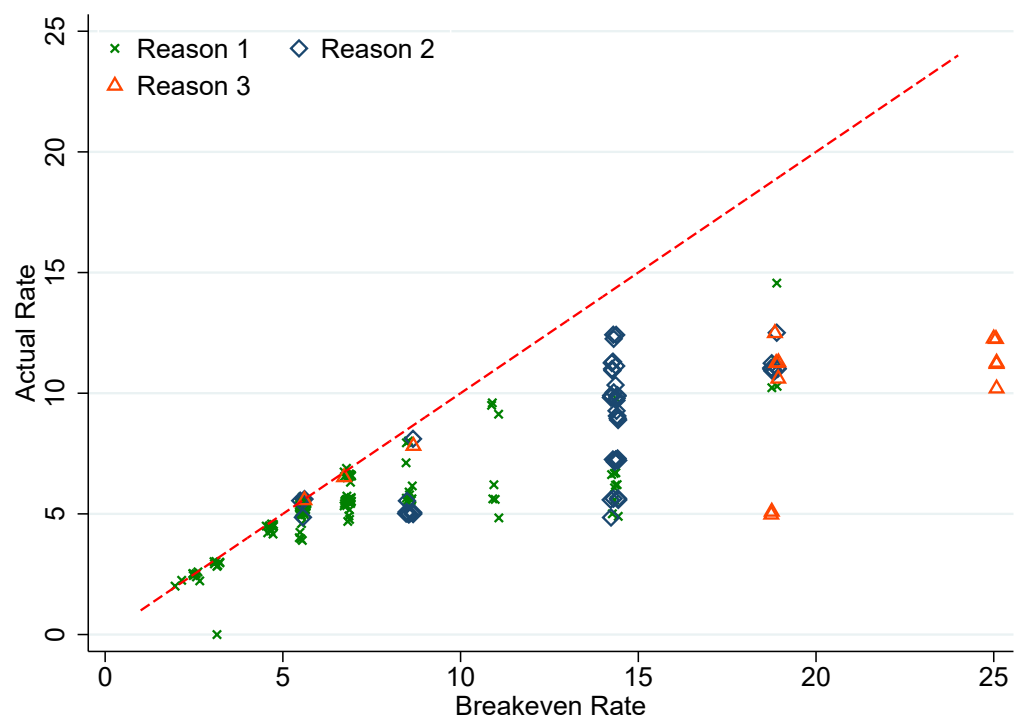
Figure 8: Alternative definitions of subsidization

This figure reports three alternative classification schemes for identifying subsidized loans. The green triangle points correspond to loans that receive a below-prime interest rate, defined as the minimum BE given to highest credit-rating firms in a month. The blue X-shaped points represent the loans for firms with interest coverage ratio below one for the previous two years. The red circle points are loans with interest rate below the BE (observations below the 45° line).
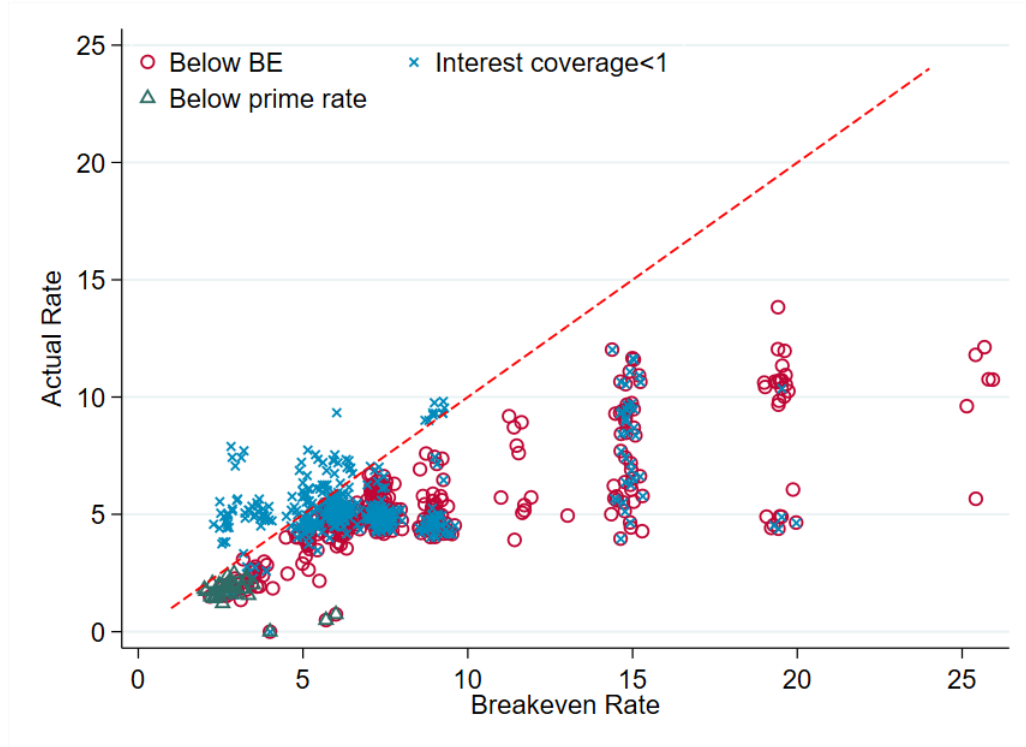
Table 1: Summary statistics

This table reports the summary statistics. Panel A reports the loan-level variables for the 1625 loans opened from 2015 and until the end of our sample period (2017m6) described in section 3.4, and Panel B reports the summary statistics for borrower-level variables for the 150 borrowers in our main sample. Detailed variable definitions are provided in Table A1 in the appendix.

Panel A: Loan-level variables

	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	1625	5.38	1.71	2.47	4.65	5.48	6.10	7.85
Breakeven Rate (%)	1625	4.76	3.34	1.97	2.36	4.64	5.57	10.98
Markup (%)	1625	0.62	2.73	-3.57	-0.02	0.49	2.28	4.46
Loan Amount (million €)	1625	3.62	14.35	0.04	0.20	0.90	2.50	10.04
Maturity (years)	1581	0.62	1.51	0.08	0.17	0.25	0.50	1.99
Collateralized (%)	1625	85.17	35.55	0.00	100.00	100.00	100.00	100.00

Panel B: Borrower-level variables

	Mean	St. Dev	P5	P25	P50	P75	P95
OROA (%)	4.59	5.97	-5.14	1.16	4.65	7.41	15.40
Deposits (million €)	18.88	81.72	0.38	1.48	4.18	9.18	58.11
Total Assets (million €)	237.88	655.06	15.86	43.02	78.35	175.72	832.10
Liabilities/Assets (%)	50.87	22.59	13.59	34.13	49.82	64.64	92.07

Table 2: Actual rate and breakeven rate

This table reports the baseline estimates of equation (18), where columns (1)-(5) incrementally add covariates. Column (6) reports the results from augmenting equation (18) with firm fixed effects. The dependent variable is the actual interest rate of each loan (in all columns). Deposits and Assets are in natural logarithms. Standard errors, which are clustered by borrower, are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Breakeven Rate	0.299***	0.310***	0.285***	0.292***	0.280***	0.095
	(0.033)	(0.031)	(0.035)	(0.039)	(0.038)	(0.097)
OROA			-0.016	-0.017	-0.026*	
			(0.019)	(0.019)	(0.016)	
Deposits			-0.076	-0.055	-0.157**	
			(0.088)	(0.091)	(0.060)	
Assets			0.082	0.068	0.268***	
			(0.132)	(0.138)	(0.101)	
Liabilities/Assets			0.004	0.003	0.002	
			(0.006)	(0.006)	(0.006)	
Maturity				-0.064	0.006	-0.002
				(0.064)	(0.043)	(0.042)
Collateral				0.242	0.001	-0.245
				(0.194)	(0.163)	(0.274)
Loan Amount				-0.034	-0.062	-0.023
				(0.044)	(0.040)	(0.018)
Observations	1625	1625	1571	1529	1486	1549
R^2	0.339	0.389	0.390	0.396	0.446	0.601
Quarter FE	No	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	Yes	No
Firm FE	No	No	No	No	No	Yes

Table 3: Lagged interest rates

This table augments equation (18) with a lagged actual rate. Specifically, Actual Rate$_{t-1}$ is calculated as the average interest rate of the borrower's loans in the most recent previous month. Columns (1)-(5) incrementally add the covariates of the specification, and column (6) includes firm fixed effects. Deposits and Assets are in natural logarithms. Standard errors, which are clustered by borrower, are reported in parentheses. *, **, and *** indicate significance of 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Breakeven Rate	0.186***	0.199***	0.184***	0.193***	0.197***	0.079
	(0.042)	(0.042)	(0.042)	(0.046)	(0.039)	(0.108)
Actual Rate$_{t-1}$	0.567***	0.556***	0.580***	0.583***	0.538***	0.525***
	(0.093)	(0.091)	(0.072)	(0.074)	(0.059)	(0.106)
OROA			-0.012	-0.010	-0.013	
			(0.015)	(0.016)	(0.013)	
Deposits			0.053	0.066	-0.030	
			(0.078)	(0.079)	(0.060)	
Assets			0.063	0.063	0.277***	
			(0.098)	(0.106)	(0.082)	
Liabilities/Assets			0.002	0.002	0.001	
			(0.005)	(0.005)	(0.005)	
Maturity				-0.007	0.001	-0.011
				(0.058)	(0.053)	(0.074)
Collateral				0.156	-0.051	-0.249
				(0.152)	(0.152)	(0.284)
Loan Amount				-0.020	-0.058	0.010
				(0.046)	(0.040)	(0.020)
Observations	1423	1423	1389	1364	1331	1376
R^2	0.447	0.488	0.490	0.498	0.530	0.614
Quarter FE	No	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	Yes	No
Firm FE	No	No	No	No	No	Yes

Table 4: Pass-through coefficients before and after the third memorandum

This table reports the results of estimating the regression (20). The sample is 2015m5-2015m12, that is, the sample encompasses the "deep crisis" period of May and June 2015 as well as the "crisis abatement" period (the six months after the signing of the third memorandum on July 13, 2015). D_{post} is an indicator variable taking the value 1 if the loan is signed after July 13, 2015. Standard errors, which are clustered by borrower, are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Actual Rate	(2) Actual Rate	(3) Actual Rate
Breakeven Rate	0.018	0.003	0.128
	(0.025)	(0.025)	(0.303)
$D_{\text{post}} \times$ Breakeven Rate	0.461***	0.465***	0.491***
	(0.035)	(0.033)	(0.025)
Observations	336	320	290
R^2	0.731	0.750	0.835
Month FE	Yes	Yes	Yes
Industry FE	No	Yes	Yes
Firm FE	No	No	Yes

Table 5: Asymmetric pass-through

The dependent variable is the actual rate of each loan in all columns. Columns (1)-(2) (columns (3)-(4)) include only borrowers with an initial BE rate in 2015 that is below (above) the median initial BE rate of the sample. Standard errors, which are clustered by borrower, are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	Below-median BE		Above-median BE	
	(1)	(2)	(3)	(4)
Breakeven Rate	0.434**	0.428**	0.041	0.044
	(0.190)	(0.181)	(0.093)	(0.092)
Maturity		0.083*		-0.082
		(0.041)		(0.077)
Collateral		-0.271		0.052
		(0.246)		(0.231)
Loan Amount		-0.027		-0.023
		(0.033)		(0.016)
Observations	544	532	883	863
R^2	0.480	0.497	0.411	0.432
Quarter FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

Table 6: Introduction of the new pricing guidelines and actual rate changes

This table reports the estimates of equation (22) in Panel A and equation (23) in Panel B. The dependent variable in Panel A is the change in the borrower's average interest rate from 2014 to 2015. The dependent variable in Panel B is the difference between the borrower's average 2015 BE rate and their average 2014 interest rate. Deposits and Assets are in natural logarithms. In Panel A, OROA, Deposits, Assets, and Liabilities/Assets are in first differences. Robust standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A: First difference			
	AR_{2015} - AR_{2014}		
	(1)	(2)	(3)
$Breakeven_{2015}$ - AR_{2014}	0.403***	0.397***	0.409***
	(0.053)	(0.055)	(0.060)
Δ $OROA_{2015}$		-0.055	-0.048
		(0.035)	(0.040)
Δ $Deposits_{2015}$		0.287*	0.263
		(0.166)	(0.173)
Δ $Assets_{2015}$		-0.344	-0.676
		(0.990)	(1.094)
Δ $Liabilities/Assets_{2015}$		-0.006	-0.003
		(0.008)	(0.009)
Observations	70	65	63
R^2	0.627	0.665	0.696
Industry FE	No	No	Yes

Panel B: Levels			
	Actual $Rate_{2015}$		
	(1)	(2)	(3)
$Breakeven_{2015}$	0.379***	0.372***	0.377***
	(0.033)	(0.039)	(0.042)
Actual $Rate_{2014}$	0.051	0.089	0.108
	(0.152)	(0.158)	(0.171)
OROA		-0.007	-0.005
		(0.023)	(0.022)
Deposits		0.023	-0.000
		(0.086)	(0.088)
Assets		0.127	0.137
		(0.154)	(0.174)
Liabilities/Assets		0.008	0.007
		(0.006)	(0.007)
Observations	70	67	65
R^2	0.725	0.744	0.763
Industry FE	No	No	Yes

Table 7: Lasso regressions with board-characteristic variables

This table reports the OLS regression and post-lasso regression using board-characteristic variables, separately for the pre-guideline period (Pre-BE) from 2013 to 2014 and post-guideline period (Post-BE) from 2015 to 2016. The dependent variable is the actual interest rate of each loan (in all columns). All variables are standardized to have zero mean and a standard deviation of 1. For each sample period, the first column reports the OLS results with the full set of board-characteristic variables. To obtain the post-lasso results in the latter column, we first run a lasso regression with all covariates after partialling out quarter fixed effects. The tuning parameter λ is chosen, where the mean-squared prediction error (MSPE) is highest but still within one standard error of the minimum MSPE (i.e., the "one standard error rule") using 10-fold cross-validation. Finally, we run an OLS regression using the covariates selected by the lasso. Deposits and Assets are in logs. Board-characteristic variables are defined in the Appendix, Table A1. Standard errors are clustered by borrower, and reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	Pre-BE		Post-BE	
	(1) OLS	(2) post-Lasso	(3) OLS	(4) post-Lasso
Breakeven Rate	0.028	0.051	0.612***	0.663***
	(0.099)	(0.114)	(0.086)	(0.066)
OROA	-0.078		-0.075	
	(0.085)		(0.070)	
Deposits	-0.013		-0.039	
	(0.139)		(0.092)	
Assets	-0.263	-0.068	-0.024	
	(0.168)	(0.090)	(0.127)	
Liabilities/Assets	-0.024	0.058	-0.015	
	(0.086)	(0.104)	(0.056)	
Maturity	-0.015		0.005	
	(0.030)		(0.025)	
Collateral	0.085	0.121*	0.045	
	(0.064)	(0.071)	(0.038)	
Founder on board	-0.199**	-0.232***	-0.005	
	(0.076)	(0.069)	(0.051)	
Family equity ownership	0.098	0.112	-0.037	
	(0.092)	(0.076)	(0.066)	
Bank executive on board	0.266**		0.038	
	(0.131)		(0.052)	
Media executive on board	0.226***	0.203***	0.079***	
	(0.037)	(0.030)	(0.019)	
Politician on board	-0.238**	-0.177*	-0.007	
	(0.098)	(0.091)	(0.058)	
Observations	1011	1011	1194	1194
R^2	0.271	0.245	0.479	0.463

Table 8: Future borrower credit rating

The dependent variable in all columns is a borrower's rating at time $t+h$, where h is measured in months. Dif_{it} is the average difference of the actual minus the BE rate across all loans of borrower i in month t, i.e., the markup in month t. Rating_{it} is the rating of borrower i at time t. Panel A shows the results for all observations. Panel B only includes observations, where the (initial) Dif_{it} is negative and Panel C only includes observations with (initially) positive Dif_{it}. A lower (higher) value of the variable "Rating" corresponds to better (worse) credit quality. Standard errors are clustered by borrower, and reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Panel A: All borrowers

	(1)	(2)	(3)	(4)	(5)
	h=12	h=24	h=36	h=48	h=60
Dif	-0.093	-0.125	-0.175	-0.192*	-0.268**
	(0.086)	(0.090)	(0.109)	(0.106)	(0.132)
Rating	0.695***	0.653***	0.487***	0.456***	0.348***
	(0.094)	(0.104)	(0.118)	(0.087)	(0.101)
Observations	744	704	686	673	664
R^2	0.485	0.444	0.293	0.281	0.218
Quarter FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No	No

Panel B: Negative Dif borrowers

	(1)	(2)	(3)	(4)	(5)
	h=12	h=24	h=36	h=48	h=60
Dif	-0.077	-0.105	0.060	-0.007	0.124
	(0.138)	(0.107)	(0.124)	(0.127)	(0.151)
Rating	0.746***	0.523***	0.604***	0.512***	0.511**
	(0.168)	(0.113)	(0.124)	(0.170)	(0.201)
Observations	173	148	143	142	141
R^2	0.676	0.625	0.584	0.509	0.329
Quarter FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No	No

Panel C: Positive Dif borrowers

	(1)	(2)	(3)	(4)	(5)
	h=12	h=24	h=36	h=48	h=60
Dif	0.111	0.111	0.116	0.029	-0.243*
	(0.163)	(0.154)	(0.213)	(0.186)	(0.146)
Rating	0.650***	0.625***	0.402***	0.392***	0.250**
	(0.108)	(0.121)	(0.143)	(0.100)	(0.121)
Observations	571	556	543	531	523
R^2	0.370	0.346	0.177	0.163	0.127
Quarter FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No	No

Table 9: Regulatory costs and actual rate

This table reports the results from augmenting the baseline equation (18) with regulatory capital costs. Columns (1)-(2) include all accounts, and column (3) includes term loans only. Column (4) only includes new credit term loans, which are defined as an account that increases the borrower's total outstanding balance by at least 10%. The dependent variable is the actual interest rate of each loan in all columns. Deposits and Assets are in natural logarithms. Standard errors are clustered by borrower, and reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3) Term Loans	(4) New Credit Term Loans
Breakeven Rate	0.245***	0.275***	0.239**	0.264***
	(0.081)	(0.078)	(0.097)	(0.093)
Regulatory Capital Cost	0.134	0.048	0.147	0.036
	(0.730)	(0.645)	(0.908)	(0.887)
OROA	-0.028	-0.026	-0.033*	-0.017
	(0.018)	(0.016)	(0.018)	(0.027)
Deposits	-0.165***	-0.157***	-0.177**	-0.099
	(0.060)	(0.060)	(0.078)	(0.144)
Assets	0.281***	0.269***	0.297**	0.238
	(0.107)	(0.103)	(0.134)	(0.180)
Liabilities/Assets	0.003	0.002	0.001	0.005
	(0.006)	(0.006)	(0.007)	(0.008)
Maturity	0.040	0.006	0.049	0.051
	(0.039)	(0.043)	(0.039)	(0.063)
Collateral	0.041	0.004	-0.083	-0.104
	(0.166)	(0.159)	(0.228)	(0.338)
Loan Amount	-0.072	-0.062	-0.043	-0.025
	(0.046)	(0.040)	(0.036)	(0.039)
Observations	1486	1486	1054	296
R^2	0.402	0.446	0.390	0.439
Quarter FE	No	Yes	No	No
Industry FE	Yes	Yes	Yes	Yes

A Appendix

A.1 Proofs

Proof of Proposition 2. Setting $V^{H,c} = \frac{D}{C}$ inside (9) and solving for $R^{H,c}$ leads to (13). To prove $R^{L,c} = \pi^L$, we argue by contradiction. Indeed, suppose (counterfactually) $R^{L,c} < \pi^L$. In that case, it must be that both in the L and the H regime, the constraints $V^{H,c} \leq \frac{D}{C}$ and $V^{L,c} \leq \frac{D}{C}$ are both binding (because the bank is only constrained by the no-poaching condition in either regime). Accordingly, (10) implies

$$R^{L,c} = (r + \rho)\frac{D}{C} - \rho C^*. \tag{25}$$

However, (7) implies

$$\pi^L < r^* - p^H (1 - C^*). \tag{26}$$

But condition (11), together with (25) and (26), implies

$$\pi^L < r^* - p^H (1 - C^*) < r\frac{D}{C} + \rho\left(\frac{D}{C} - C^*\right) = R^{L,c}.$$

This contradicts the assumption that $R^{L,c} < \pi^L$. Therefore, it must be that $R^{L,c} = \pi^L$.

Using $R^{L,c} = \pi^L$ inside (10) and using $V^{H,c} = \frac{D}{C}$ leads to (14). Assumption (12) implies liquidation of the firm in the low regime is not optimal. □

Proof of Proposition 3. Proposition 2 implies

$$\frac{R^{L,c} - R^{H,c}}{\rho(1 - C^*)} = \frac{\pi^L - R^{H,c}}{\rho(1 - C^*)} = \frac{\pi^L - \left(r + (r + \rho)\left(\frac{D}{C} - 1\right) + p^L\left(\frac{D}{C} - V^{L,c}\right)\right)}{\rho(1 - C^*)}. \tag{27}$$

Conditions (11) and (26) imply

$$\pi^L < r\frac{D}{C} + \rho\left(\frac{D}{C} - C^*\right). \tag{28}$$

Combining (27) with (28) leads to

$$
\begin{aligned}
\frac{R^{L,c} - R^{H,c}}{\rho\left(1 - C^*\right)} \;&<\; \frac{r\frac{D}{C} + \rho\left(\frac{D}{C} - C^*\right) - \left(r + (r + \rho)\left(\frac{D}{C} - 1\right) + p^L\left(\frac{D}{C} - V^{L,c}\right)\right)}{\rho\left(1 - C^*\right)} \\
&=\; \frac{\rho\left(1 - C^*\right) - p^L\left(\frac{D}{C} - V^{L,c}\right)}{\rho\left(1 - C^*\right)} = 1 - p^L\frac{\left(\frac{D}{C} - V^{L,c}\right)}{\rho\left(1 - C^*\right)} \\
&\leq\; 1,
\end{aligned}
$$

where the last line follows from the no-poaching condition $V^{L,c} \leq \frac{D}{C}$. $\qquad\square$

Proof of Proposition 4. First we note that $R^{L,c} = \pi^L$ is independent of $\frac{D}{C}$, so that $\frac{\partial(R^{L,c} - R^{H,c})}{\partial(\frac{D}{C})} = -\frac{\partial(R^{H,c})}{\partial(\frac{D}{C})}$. Substituting the expression for $V^{L,c}$ from equation (14) into (13) and differentiating gives $-\frac{\partial(R^{H,c})}{\partial(\frac{D}{C})} = -[(r + \rho) + p^L\frac{r+\rho}{r+\rho+p^H}] < 0$. Second, from $R^{L,c} = \pi^L$ and (13), we obtain $\frac{\partial(R^{L,c} - R^{H,c})}{\partial\pi^L} = 1 + \frac{p^L}{r+\rho+p^H} > 0$. $\qquad\square$

A.2   Additional figures and tables

Figure A1: New accounts by type

This figure reports the number of new accounts by type – namely, term loan or credit line – for each month in the sample period. The dark-blue bars correspond to the number of new term loans in the month, and the light-brown bars represent the number of new credit-line accounts.
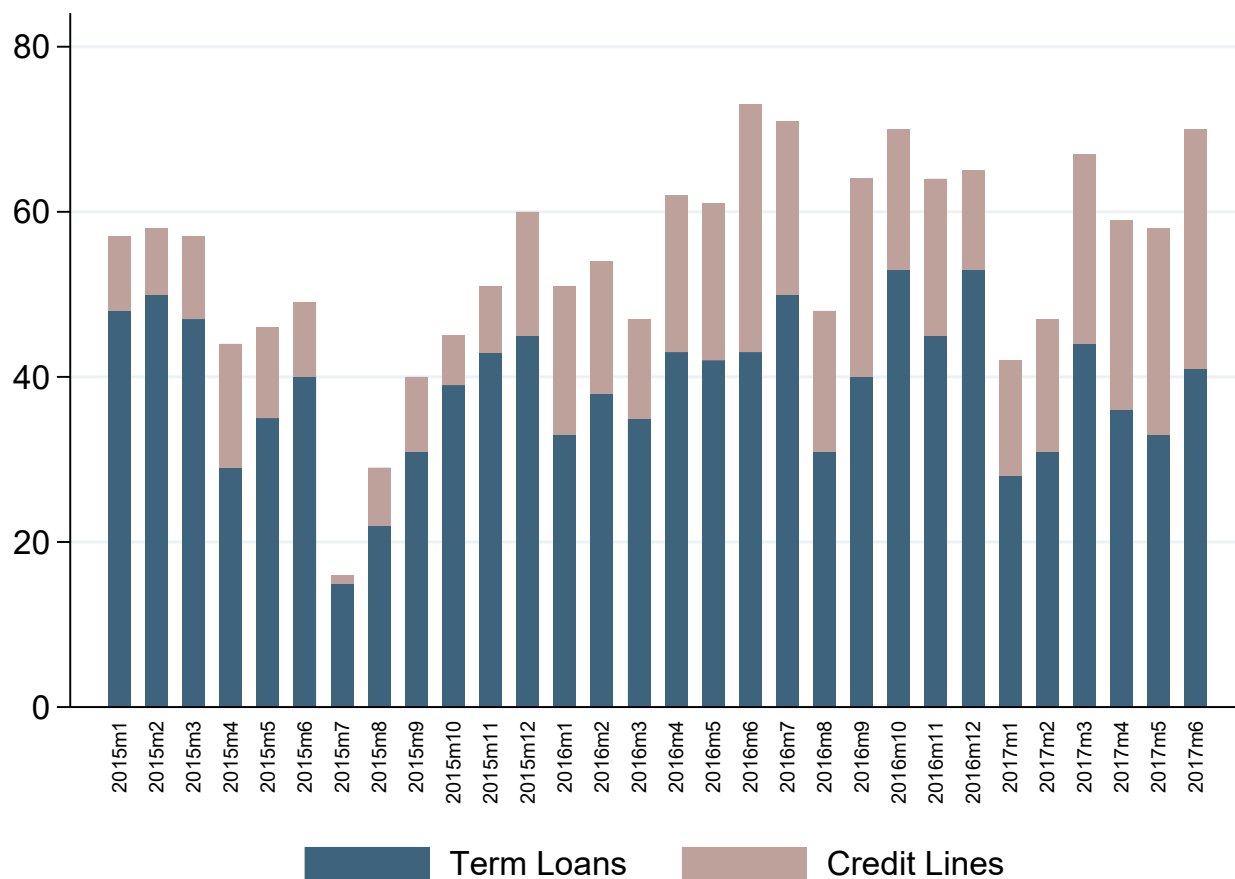
Figure A2: Actual rates and breakeven rates in 2014 and 2015

This figure shows the scatter plot of actual and BE rates for 2014 and 2015. The red dashed line corresponds to the 45° line. The blue solid line notes the OLS fitted line. Black circles correspond to term loans and brown circles correspond to credit lines.

Panel A: 2014

Panel B: 2015
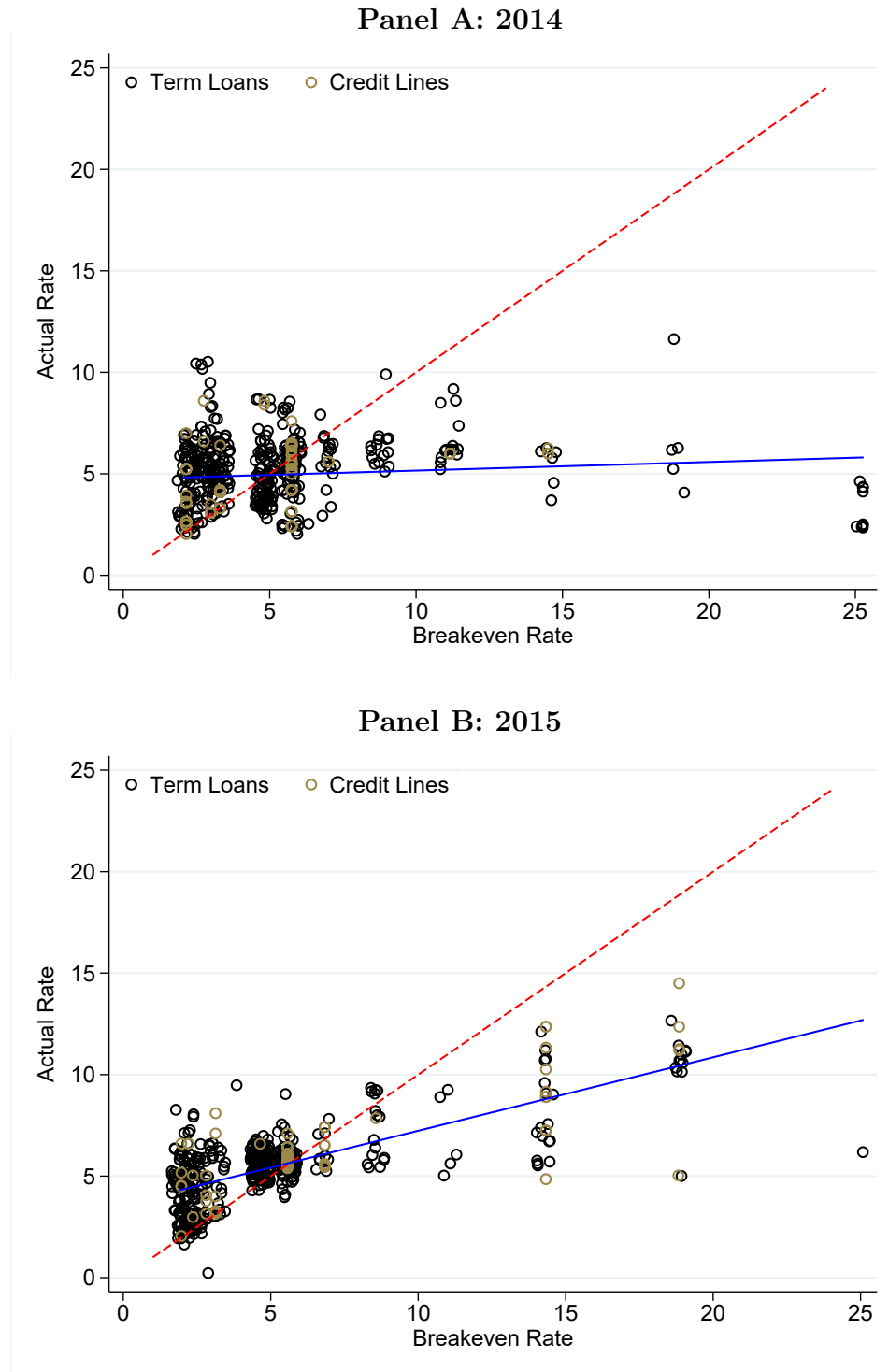
Figure A3: Borrower composition

The figure includes borrowers who receive a loan in 2015 and furthermore appear in the sample in at least two separate quarters. Borrowers are sorted by how frequently they initiate loans from the most frequent (bottom rows) to the less frequent (top rows). A filled box indicates that the borrower opens a new loan with the bank in the respective quarter. The colors show whether the borrower exhibits an initial *Markup* (the difference between the actual interest rate and BE rate) in the top tercile (dark red), medium tercile (medium red), or low tercile (light red). Reported coefficients and standard errors (in parentheses) under each column refer to a logit regression with a dependent variable that takes the value 1 if the borrower opens a new loan in the respective quarter (and 0 otherwise) and the initial Markup (difference between actual and BE rate) as the independent variable.

2015q1	2015q2	2015q3	2015q4	2016q1	2016q2	2016q3	2016q4	2017q1	2017q2
−0.005	0.098	0.031	0.039	0.014	0.040	0.085	0.089	0.105	0.126
(0.046)	(0.055)	(0.053)	(0.050)	(0.049)	(0.048)	(0.054)	(0.054)	(0.061)	(0.061)

No loan   Low Dif   Med Dif   High Dif
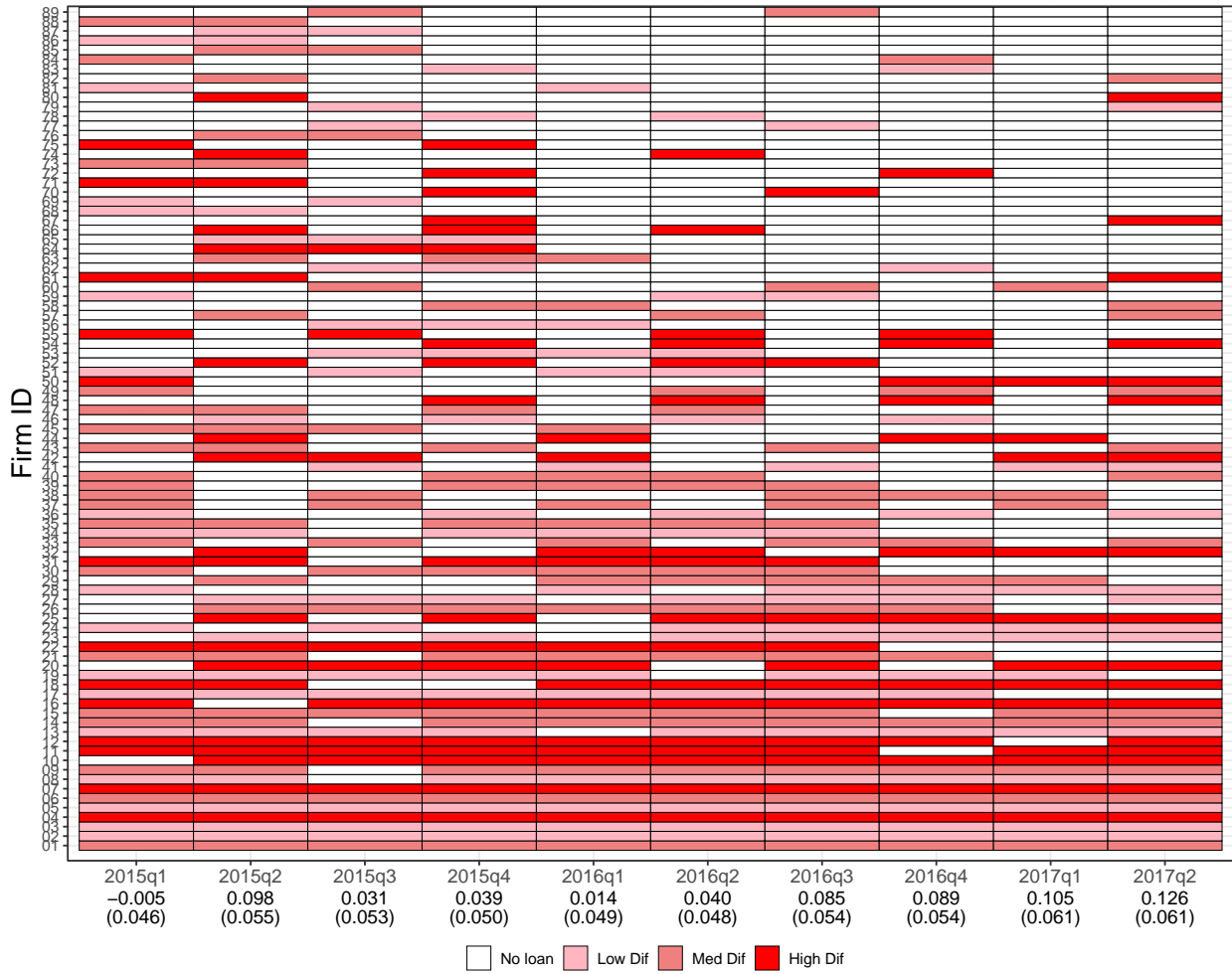
Table A1: Variable definitions

Variable	Definition
Borrower-level Variables	
OROA	Defined as EBIT/(Total Assets)
Deposits	Reported in euros
Assets	Reported in euros
Liabilities/Assets	Defined as (Current Liabilities)/(Total Assets)
Industry	
Rating	The bank's credit rating of the borrower; lower rating corresponds to higher credit quality
Loan-level Variables	
Actual Rate	Interest rate of the loan
Breakeven Rate	The breakeven interest rate for the loan as computed by the bank's own pricing department
Markup	Defined as $actual\ rate - breakeven\ rate$
Loan Amount	Reported in euros
Maturity	Maturity of the loan in years at issuance
Collateralization	An indicator variable that takes a value 1 if the loan belongs to a borrower who has provided collateral in that month
Board-Characteristic Variables	
Founder on board	The founder is on the board
Family equity ownership	The founder family's ownership of outstanding equity
Bank executive on board	Number of board members who are or were bank executives
Media executive on board	Number of board members who are or were media executives
Politician on board	Number of board members who have or had political affiliations

Table A2: Summary statistics by breakeven rate - actual rate difference

This table reports the summary statistics for loan-level variables and borrower-level variables in our main sample. Detailed variable definitions are provided in Table A1. Panel A reports the summary statistics only for loans with a rate higher than their breakeven rate. Panel B reports the results only for below-breakeven loans. Similarly, Panel C only includes the borrowers who never receive a below-breakeven loan from 2015 and until the end of our sample period (2017m6), and Panel D only includes the borrowers who receive at least one below-breakeven loan.

Panel A: Above-breakeven loans

	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	1211	5.22	1.52	2.36	4.59	5.55	6.10	7.60
Breakeven Rate (%)	1211	3.56	1.52	1.97	2.21	2.81	4.64	5.57
Dif (%)	1211	1.66	1.52	0.10	0.35	1.21	2.63	4.63
Loan Amount (million €)	1211	3.86	16.07	0.04	0.20	0.86	2.33	10.09
Maturity (years)	1181	0.58	1.49	0.08	0.13	0.25	0.50	2.01
Collateralized (%)	1211	83.90	36.77	0.00	100.00	100.00	100.00	100.00

Panel B: Below-breakeven loans

	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	414	5.87	2.11	2.90	5.01	5.41	6.17	11.02
Breakeven Rate (%)	414	8.27	4.54	3.13	5.57	6.83	8.57	18.85
Dif (%)	414	-2.40	3.20	-8.73	-3.57	-1.34	-0.23	-0.06
Loan Amount (million €)	414	2.93	7.19	0.03	0.20	1.00	2.87	10.01
Maturity (years)	400	0.76	1.54	0.08	0.23	0.41	0.75	1.88
Collateralized (%)	414	88.89	31.46	0.00	100.00	100.00	100.00	100.00

Panel C: Above-breakeven borrowers

	Mean	St. Dev	P5	P25	P50	P75	P95
OROA (%)	6.85	5.87	-0.17	3.01	5.79	9.58	17.04
Deposits (million €)	24.94	118.53	0.51	1.36	3.82	7.10	28.22
Total Assets (million €)	263.56	939.87	13.47	33.88	65.75	106.65	531.45
Liabilities/Assets (%)	50.33	21.17	14.74	32.35	50.83	62.27	84.80

Panel D: Below-breakeven borrowers

	Mean	St. Dev	P5	P25	P50	P75	P95
OROA (%)	2.88	5.48	-6.72	-0.79	3.12	6.17	11.85
Deposits (million €)	14.31	34.11	0.21	1.48	4.43	10.20	69.04
Total Assets (million €)	218.37	300.20	21.95	55.62	116.65	278.67	865.85
Liabilities/Assets (%)	51.27	23.74	9.85	35.27	49.74	65.94	92.63

Table A3: Summary statistics for account-level variables, term loans

This table reports the summary statistics for the account-level variables in Table 1, but only for term loans.

Panel A: All accounts								
	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	1163	5.21	1.76	2.36	4.45	5.25	6.10	7.85
Breakeven Rate (%)	1163	4.36	3.41	1.97	2.21	3.13	5.57	10.98
Markup (%)	1163	0.85	2.82	-3.57	0.12	0.72	2.53	4.63
Loan Amount (million €)	1163	4.59	16.68	0.05	0.30	1.00	3.01	16.83
Maturity (years)	1143	0.71	1.76	0.08	0.09	0.25	0.50	3.01
Collateralized (%)	1163	83.40	37.22	0.00	100.00	100.00	100.00	100.00

Panel B: Above-breakeven accounts								
	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	932	5.05	1.53	2.35	4.10	5.20	6.06	7.60
Breakeven Rate (%)	932	3.30	1.39	1.97	2.21	2.57	4.64	5.57
Markup (%)	932	1.75	1.53	0.08	0.43	1.32	2.79	4.63
Loan Amount (million €)	932	4.63	18.05	0.05	0.30	1.00	2.90	16.49
Maturity (years)	917	0.66	1.68	0.08	0.09	0.25	0.50	3.00
Collateralized (%)	932	82.73	37.82	0.00	100.00	100.00	100.00	100.00

Panel C: Below-breakeven accounts								
	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	231	5.87	2.37	2.38	4.84	5.47	6.58	11.02
Breakeven Rate (%)	231	8.67	5.26	2.57	5.57	6.83	10.98	18.85
Markup (%)	231	-2.81	3.73	-12.35	-4.07	-1.07	-0.23	-0.03
Loan Amount (million €)	231	4.44	9.28	0.04	0.50	2.00	3.65	24.18
Maturity (years)	226	0.90	2.02	0.08	0.22	0.26	0.50	4.58
Collateralized (%)	231	86.15	34.62	0.00	100.00	100.00	100.00	100.00

Table A4: Summary statistics for account-level variables, credit lines

This table reports the summary statistics for the account-level variables in Table 1, but only for credit-line accounts.

Panel A: All accounts								
	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	462	5.82	1.51	3.26	5.25	5.59	6.42	8.90
Breakeven Rate (%)	462	5.76	2.94	2.21	4.64	5.57	6.83	8.57
Markup (%)	462	0.06	2.40	-3.57	-1.30	0.14	1.14	4.46
Loan Amount (million €)	462	1.18	3.94	0.03	0.11	0.31	1.16	3.95
Maturity (years)	438	0.41	0.27	0.14	0.21	0.38	0.41	0.96
Collateralized (%)	462	89.61	30.55	0.00	100.00	100.00	100.00	100.00

Panel B: Above-breakeven accounts								
	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	279	5.79	1.35	3.15	5.52	5.71	6.76	7.85
Breakeven Rate (%)	279	4.45	1.61	1.97	2.81	5.57	5.57	5.57
Markup (%)	279	1.34	1.44	0.12	0.14	0.94	2.28	4.46
Loan Amount (million €)	279	1.29	4.95	0.03	0.11	0.26	0.86	3.95
Maturity (years)	264	0.30	0.16	0.13	0.21	0.23	0.38	0.50
Collateralized (%)	279	87.81	32.77	0.00	100.00	100.00	100.00	100.00

Panel C: Below-breakeven accounts								
	Count	Mean	St. Dev	P5	P25	P50	P75	P95
Actual Rate (%)	183	5.87	1.72	5.00	5.25	5.40	5.51	10.25
Breakeven Rate (%)	183	7.75	3.36	5.57	5.57	6.83	8.57	14.33
Markup (%)	183	-1.88	2.26	-6.49	-2.06	-1.43	-0.20	-0.06
Loan Amount (million €)	183	1.02	1.40	0.02	0.11	0.45	1.37	3.99
Maturity (years)	174	0.57	0.31	0.19	0.38	0.41	0.94	0.96
Collateralized (%)	183	92.35	26.65	0.00	100.00	100.00	100.00	100.00

Table A5: Actual rate and breakeven rate, term loans

The following table presents the results from regressions of actual rate on breakeven rate as in Table 2, but for term loans only.

	(1)	(2)	(3)	(4)	(5)	(6)
Breakeven Rate	0.292***	0.309***	0.289***	0.291***	0.281***	0.065
	(0.037)	(0.034)	(0.043)	(0.044)	(0.043)	(0.067)
OROA			-0.023	-0.022	-0.029*	
			(0.018)	(0.018)	(0.015)	
Deposits			-0.014	-0.003	-0.158**	
			(0.096)	(0.098)	(0.077)	
Assets			0.038	0.090	0.265**	
			(0.139)	(0.131)	(0.124)	
Liabilities/Assets			0.004	0.004	-0.000	
			(0.007)	(0.007)	(0.006)	
Maturity				-0.044	0.008	-0.015
				(0.066)	(0.045)	(0.048)
Collateral				0.119	-0.142	-0.454
				(0.230)	(0.200)	(0.351)
Loan Amount				-0.085**	-0.047*	-0.052***
				(0.037)	(0.028)	(0.018)
Observations	1163	1163	1114	1095	1054	1112
R^2	0.320	0.400	0.402	0.409	0.456	0.632
Quarter FE	No	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	Yes	No
Firm FE	No	No	No	No	No	Yes

Table A6: Actual rate and breakeven rate, credit lines

The following table presents the results from regressions of actual rate on breakeven rate as in Table 2, but for credit line accounts only.

	(1)	(2)	(3)	(4)	(5)	(6)
Breakeven Rate	0.298***	0.304***	0.230***	0.232**	0.209*	0.187
	(0.064)	(0.067)	(0.049)	(0.090)	(0.109)	(0.193)
OROA			0.047	0.066	0.058	
			(0.047)	(0.085)	(0.093)	
Deposits			-0.492***	-0.550*	-0.525	
			(0.149)	(0.304)	(0.336)	
Assets			0.439***	0.538	0.444	
			(0.156)	(0.304)	(0.316)	
Liabilities/Assets			0.009	0.020	0.024	
			(0.010)	(0.016)	(0.020)	
Maturity				-0.177	0.121	2.555
				(0.923)	(1.181)	(2.050)
Collateral				1.060**	0.663**	0.152
				(0.355)	(0.295)	(0.299)
Loan Amount				-0.063	-0.064	-0.041
				(0.075)	(0.075)	(0.037)
Observations	462	462	457	434	432	437
R^2	0.338	0.381	0.440	0.485	0.492	0.570
Quarter FE	No	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	Yes	No
Firm FE	No	No	No	No	No	Yes

Table A7: Regressions by loan-size quartile

The table reports results of our baseline regressions on three separate subsamples formed on loan size. Specifically, the first column pertains to loans in the first tercile of loan size. The second column pertains to loans in the second tercile of loan size. The final column pertains to loans in the third tercile of loan size. The dependent variable is the actual interest rate of each loan (in all columns). Deposits and Assets are in natural logarithms. Standard errors, which are clustered by borrower, are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Low	(2) Med	(3) High
Breakeven Rate	0.292***	0.318***	0.192***
	(0.052)	(0.044)	(0.046)
OROA	-0.006	-0.030	-0.049***
	(0.032)	(0.022)	(0.016)
Deposits	-0.544***	-0.115	-0.225**
	(0.129)	(0.097)	(0.094)
Assets	0.712***	0.043	0.272**
	(0.192)	(0.198)	(0.120)
Liabilities/Assets	0.013	0.002	-0.004
	(0.010)	(0.009)	(0.004)
Maturity	0.146	0.044	-0.025
	(0.129)	(0.064)	(0.046)
Collateral	-0.055	0.159	-0.188
	(0.266)	(0.246)	(0.178)
Observations	496	495	495
R^2	0.619	0.479	0.385
Quarter FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Firm FE	No	No	No

Table A8: Regressions with loan-size quartile interacted with the breakeven rate

The table reports the same results as Table A7, except that now we estimate a single regression each time with indicator variables for the loan-size tercile of each loan and interaction terms between an indicator of the size tercile and the breakeven rate. The dependent variable is the actual interest rate of each loan (in all columns). Deposits and Assets are in natural logarithms. Standard errors, which are clustered by borrower, are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
Breakeven Rate	0.316***	0.321***	0.308***	0.308***	0.312***
	(0.049)	(0.050)	(0.047)	(0.047)	(0.042)
Med	-0.262	-0.264	-0.156	-0.131	-0.180
	(0.306)	(0.287)	(0.302)	(0.302)	(0.262)
High	0.087	0.065	0.202	0.254	0.229
	(0.425)	(0.403)	(0.416)	(0.406)	(0.355)
Med × Breakeven Rate	0.013	0.026	0.008	0.008	-0.010
	(0.046)	(0.046)	(0.046)	(0.047)	(0.039)
High × Breakeven Rate	-0.045	-0.036	-0.064	-0.066	-0.094
	(0.070)	(0.069)	(0.069)	(0.069)	(0.057)
OROA			-0.024	-0.026	-0.029*
			(0.020)	(0.021)	(0.016)
Deposits			-0.070	-0.052	-0.172***
			(0.097)	(0.100)	(0.062)
Assets			0.060	0.035	0.250**
			(0.140)	(0.147)	(0.106)
Liabilities/Assets			0.003	0.003	0.002
			(0.006)	(0.006)	(0.006)
Maturity				-0.013	-0.009
				(0.048)	(0.043)
Collateral				0.256	-0.015
				(0.196)	(0.156)
Observations	1486	1486	1486	1486	1486
R^2	0.343	0.396	0.403	0.406	0.451
Quarter FE	No	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	Yes
Firm FE	No	No	No	No	No

Table A9: Industry Exposure

The sample contains industry classification for firms whose total outstanding balance of loans make up approximately 68% of the total loan balance. Of the five major industry groups, three make up a small portion (1.7%, 3.5%, 12% of the bank's outstanding loan balance during sample period) and are coded as "low exposure" industries. The other two industry classes (21.7%, 28.9% of bank's outstanding loan balance) are coded as "high exposure." The dependent variable is the actual interest rate of each loan (in all columns). The first two columns run our baseline regression separately for low- and high-exposure industries. The third column runs a single regression with the variable "high exposure" defined as an indicator variable taking the value 1 if the loan is extended to a firm that belongs in one of the two high-exposure industries. Deposits and Assets are in natural logarithms. Standard errors, which are clustered by borrower, are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Low	(2) High	(3) Int
Breakeven Rate	0.339***	0.262***	0.262***
	(0.084)	(0.040)	(0.085)
OROA	-0.018	-0.036	-0.029
	(0.026)	(0.022)	(0.019)
Deposits	0.223*	-0.195**	-0.025
	(0.131)	(0.084)	(0.110)
Assets	-0.378*	0.236**	-0.001
	(0.194)	(0.109)	(0.143)
Liabilities/Assets	0.004	-0.004	0.004
	(0.008)	(0.008)	(0.006)
Maturity	-0.138	-0.003	0.006
	(0.096)	(0.043)	(0.041)
Collateral	0.346	0.108	0.263
	(0.238)	(0.239)	(0.196)
high exposure			0.072
			(0.519)
high exposure × Breakeven Rate			0.030
			(0.097)
Observations	703	783	1486
R^2	0.445	0.466	0.405
Quarter FE	Yes	Yes	Yes
Industry FE	No	No	No
Firm FE	No	No	No

Table A10: Regressions by firm-size tercile

The table reports results of our baseline regressions on three separate subsamples formed on firm size. Specifically, the first (second, third) column pertains to loans in the first (second, third) tercile of firm size sorted by 2016 assets (or most recent observation). The dependent variable is the actual interest rate of each loan (in all columns). Deposits and Assets are in natural logarithms. Standard errors, which are clustered by borrower, are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) Low	(2) Med	(3) High
Breakeven Rate	0.217**	0.255***	0.295***
	(0.106)	(0.048)	(0.031)
OROA	-0.016	-0.016	-0.036
	(0.021)	(0.028)	(0.023)
Deposits	0.078	-0.420***	-0.134
	(0.125)	(0.098)	(0.100)
Assets	-0.364	1.375***	0.451*
	(0.321)	(0.490)	(0.232)
Liabilities/Assets	0.006	-0.011	-0.021*
	(0.011)	(0.009)	(0.011)
Maturity	-0.017	0.062	-0.169*
	(0.133)	(0.054)	(0.093)
Collateral	-0.253	0.260	0.676***
	(0.242)	(0.293)	(0.156)
Observations	496	538	452
R^2	0.431	0.599	0.552
Quarter FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Firm FE	No	No	No

Table A11: Future BE

This table reports the results of regressions of breakeven rates at time $t + h$ (where h takes values 1-8 quarters ahead) on time-t breakeven rates and time-t actual interest rates. Standard errors are clustered by borrower, and reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) 1Q	(2) 2Q	(3) 3Q	(4) 4Q	(5) 5Q	(6) 6Q	(7) 7Q	(8) 8Q
Breakeven Rate	0.899***	0.774***	0.608***	0.532***	0.465***	0.395***	0.480***	0.333***
	(0.053)	(0.074)	(0.105)	(0.061)	(0.102)	(0.081)	(0.114)	(0.107)
Actual Rate	0.022	0.127	0.156	0.301**	0.197	0.198*	0.098	0.265*
	(0.049)	(0.087)	(0.126)	(0.129)	(0.171)	(0.112)	(0.122)	(0.138)
Observations	279	266	198	182	129	104	69	48
R^2	0.902	0.675	0.586	0.516	0.369	0.417	0.593	0.493

Table A12: Future borrowing

The following table reports the results of regressing future borrowing (i.e., number of loans, total balance) on the initial post-reform interest-rate adjustment (Panel A) and the initial markup (Panel B). Specifically, the initial adjustment is defined as $AR_{2015} - AR_{2014}$ and the initial markup is defined as $AR_{2015} - BE_{2015}$. In Panel A, OROA, Deposits, Assets, and Liabilities/Assets are in first differences. Robust standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	Δ Loans$_{2015}$				Δ Balance$_{2015}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Initial adjustment	-0.063	0.002			-0.063	0.018		
	(0.263)	(0.307)			(0.127)	(0.099)		
Initial markup			-0.126	-0.056			0.039	-0.007
			(0.208)	(0.252)			(0.092)	(0.084)
Δ OROA$_{2015}$		0.265*		0.264*		0.021		0.020
		(0.150)		(0.151)		(0.030)		(0.031)
Δ Deposits$_{2015}$		-2.064		-2.036		-0.134		-0.129
		(1.269)		(1.281)		(0.136)		(0.153)
Δ Assets$_{2015}$		-7.126		-7.160		1.154		1.124
		(7.450)		(7.502)		(1.105)		(1.115)
Δ Liabilities/Assets$_{2015}$		0.015		0.018		0.027**		0.027**
		(0.028)		(0.028)		(0.010)		(0.011)
Observations	65	63	65	63	65	63	65	63
R^2	0.247	0.334	0.249	0.334	0.104	0.251	0.101	0.250
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

A.3 Additional theoretical results

A.3.1 Heterogeneous bank discount rates

In the baseline version of the model we assume that all banks use the same discount rate r. This this is purely for simplicity, and so as to expedite the presentation of the empirical results, which are the focus of the paper. From a theory standpoint, allowing r to differ across banks is straightforward and helps better clarify the implications of limit pricing.

Specifically, suppose that there are two banks that we index with $j \in \{A, B\}$. The first bank faces discount rate r_A, and the second one discount rate r_B. The valuation of a loan that collects the interest rate $R^{H,c}$ from the borrower in the high profitability regime and π^L in the low profitability regime is given by the pricing equations

$$R^{H,c} + p^L \left(V_j^{L,c} - V_j^{H,c} \right) + \rho \left(1 - V_j^{H,c} \right) = r_j V_j^{H,c}, \tag{29}$$

$$\pi^L + p^L \left(V_j^{H,c} - V_j^{L,c} \right) + \rho (C^* - V_j^{L,c}) = r_j V_j^{L,c}, \tag{30}$$

where the subscript $j \in \{A, B\}$ denotes the bank, and $V_j^{H,c}$ $\left(\text{resp. } V_j^{L,c} \right)$ is the value of the loan to bank j for a firm in the profitability regime H (resp. L) during the crisis (c). (We assume that the constraint $R^{L,c} \leq \pi^L$ is binding in the low profitability regime, so that the interest rate charged by either bank in that regime is constrained by the borrower's ability to pay, π^L.) Note that the right hand side of equations (29) and (30) reflects how the discount rate, r_j, differs by bank.

For a given $R^{H,c}$, equations (29) and (30) are a linear system of two equations in two unknowns, $V_j^{H,c}$ and $V_j^{L,c}$. If the loan currently resides with bank A, the limit pricing requirement, i.e., the condition that prevents poaching by bank B can be expressed as $V_B \left(R^{H,c} \right) \leq \frac{D_B}{C}$, where D_B is the value of bank $B's$ lowest valued loan.

Intuitively, the limit pricing requirement states that the rate $R^{H,c}$ is set by bank A so that the valuation of the loan from bank $B's$ perspective, $V_B \left(R^{H,c} \right)$ is not attractive enough to induce bank B to poach the loan. To ensure that the value of the loan from bank $B's$ perspective is no larger than the opportunity cost of bank $B's$ funds, Bank A takes into

account that in order to raise a dollar, Bank B would have to liquidate $\frac{1}{C}$ of its (least valued) loans, and collect the collateral value C per liquidated loan, so that $\frac{1}{C} \times C = 1$. Therefore the opportunity cost of raising a dollar from bank $B's$ perspective is $\frac{1}{C} \times D_B$, i.e., the total value of the loans it would have to liquidate to raise a dollar. As long as $V_B\left(R^{H,c}\right) \leq \frac{D_B}{C}$, poaching is not profitable.

There are some interesting implications of limit pricing (which is the consequence of the assumption that bank capital is in fixed rather than elastic supply during the crisis). First, limit pricing implies that banks' discount rates, r_j, are not a sufficient statistic for their loan pricing decisions. Each competitor bank's opportunity cost of a dollar, $\frac{D_j}{C}$, also plays a key role. This opportunity cost depends on the bank's portfolio of existing loans. Second, with limit pricing, the key issue is not so much a bank's own discount rate, but rather the discount rate of its competitors (along with their opportunity cost of funds). If one takes two firms with identical characteristics, they could get charged different rates depending on the bank that owns their loan.

A.3.2 Precautionary Pre-crisis capital accumulation

In this section we extend the model by allowing for a pre-crisis state. During that state we assume that there are some specialized lenders who invest their funds in riskless assets (e.g, cash) that have a lower rate of return rather than the risky projects that the banks are financing. The goal of the specialized lenders is to deploy their capital at the onset of a crisis by poaching high-profitability borrowers, and capturing some of the banks' rents.

The main insight of this section is that the presence of specialized lenders may help reduce the rents of the banks, but will always fall short of eliminating those rents. The reason is that accumulating capital in the pre-crisis state is costly: The specialized lenders have to "keep their powder dry" during the pre-crisis state, i.e., invest in safe, liquid, but low yielding assets that are readily deployable at the onset of the crisis. (Otherwise, they would be faced with the same deadweight costs of liquidation as banks at the onset of the crisis.[41])

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[41]Recall that banks are forced to hold on to some low profitability loans during the crisis. They cannot liquidate these loans because of low collateral values. By investing in liquid, but low-yielding assets, the specialized lenders can avoid the deadweight costs of liquidation. Otherwise they would be faced with the same tradeoffs as banks.

Since keeping the powder dry involves investing in low-yielding assets, the specialized lenders need to be compensated with some rents during the crisis. Indeed, the main result of this section can be summarized by the asset-pricing equation

$$\underbrace{R}_{\text{lender's discount rate}} - \underbrace{R^I}_{\text{Return on low-yield assets}} = \underbrace{\rho^c \left(\frac{D}{C} - 1 \right)}_{\text{Expected gain from poaching}} \tag{31}$$

which states that the difference between a specialized lender's discount rate, R, and the rate of return that she earns on liquid assets, R^I, must equal the expected gain from poaching a high-profitability borroewer at the onset of the next crisis. In turn, the expected gain from poaching is equal to the product of the hazard rate of entering the crisis state, ρ^c, times the rents from a high-profitability loan, $\frac{D}{C} - 1$. As long as $R - R^I > 0$, it follows that $\frac{D}{C} - 1 > 0$, and therefore the specialized lenders will always stop short of eliminating the rents on high-profitability loans. An implication of this statement is that our results on limited pass-through, would survive (Proposition 3), because $\frac{D}{C} > 1$ is the key condition for those results.

In the remainder of this section, we derive equation (31). We start by stating some assumptions that describe what happens at the onset of the crisis. Specifically, we assume that at the onset of the crisis the total capital available to the banking sector drops from K to K_{0+}, where $K_{0+} < K$. This assumption is meant to capture the notion of scarce capital in the banking sector during the crisis.

Assuming that all banks face the same discount rate, we next determine the equilibrium value of minimally profitable loan, D as a function of the capital shortfall at the onset of the crisis, $\frac{K_{0+}}{K}$.

Proposition 5. *Let $F\left(\pi_i^L\right)$ denote the cumulative distribution of π_i^L among firms in the low profitability regime. Define $z_i \equiv \pi_i^H + \frac{p^L}{r+\rho+p^H}\pi_i^L$, and let $G\left(z_i\right)$ denote the distribution of z_i among firms in the high profitability regime. Also define*

$$z^*\left(D\right) \equiv \frac{D}{C}\left[(r+\rho)\left(1 + \frac{p^L}{r+\rho+p^H}\right)\right] - \rho - p^L \frac{\rho C^*}{r+\rho+p^H}, \tag{32}$$

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and

$$\pi^{L,*}(D) \equiv D\left(r + \rho - p^H\left(\frac{1}{C} - 1\right)\right) - \rho C^*. \tag{33}$$

Assume that at the onset of the crisis the fraction of H firms is $\mu^H = \frac{p^H}{p^H + p^L}$, while the

fraction of L firms is $\mu^L = \frac{p^L}{p^H + p^L}$. Also assume that

$$F\left(\pi^{L,*}(D)\right) = G\left(z^*(D)\right) \quad \text{for all } D. \tag{34}$$

Then, in an equilibrium where there is some non-zero pre-crisis capital accumulation, the value of D at the beginning of the crisis is given by the solution of the equation

$$D(K_{0+}) = \frac{F^{-1}\left(1 - \frac{K_{0+}}{K}\right) + \rho C^*}{r + \rho - p^H\left(\frac{1}{C} - 1\right)}, \tag{35}$$

where $F^{-1}(1 - \frac{K_{0+}}{K})$ is the quantile function (inverse of the distribution function, F) evaluated at $1 - \frac{K_{0+}}{K}$.

Proof of Proposition . From equation (14) we have that $V_i^{L,c} \geq D$ is equivalent to

$$\pi_i^L \geq \pi^{L,*}(D) = D\left(r + \rho - p^H\left(\frac{1}{C} - 1\right)\right) - \rho C^*. \tag{36}$$

Similarly, by equation (13) the requirement $\pi_i^H \geq R_i^H$ is equivalent to

$$\begin{aligned} z_i &= \pi_i^H + \frac{p^L}{r + \rho + p^H}\pi_i^L \geq z^*(D) \\ &= \frac{D}{C}\left[(r + \rho)\left(1 + \frac{p^L}{r + \rho + p^H}\right)\right] - \rho - p^L\frac{\rho C^*}{r + \rho + p^H} \end{aligned} \tag{37}$$

Assumption (34) ensures that the fraction of low-profitability-regime firms that satisfy $V_i^{L,c} \geq D$, (i.e., the requirement (33)) is equal to the high-profitability-firms that satisfy $\pi_i^H \geq R_i^H$, (i.e., the requirement (37)). Accordingly, if the equilibrium value of the minimally profitable project is D, the fraction of projects that will survive immediately after the onset of the

crisis is given by

$$\underbrace{\mu^H \left(1 - G\left(z_i^*\left(D\right)\right)\right)}_{L-\text{regime firms with } \pi_i \geq R_i^H} + \underbrace{\mu^L \left(1 - F\left(\pi_i^{L,*}\left(D\right)\right)\right)}_{H-\text{regime firms with } V_i^{L,c} \geq D} = \left(\mu^H + \mu^L\right)\left(1 - F\left(\pi_i^{L,*}\left(D\right)\right)\right),$$

where we have used (34). In equilibrium, the fraction of surviving projects at the onset of the crisis must equal the fraction of capital that remained in the banking system, which leads to equation

$$\left(\mu^H + \mu^L\right)\left(1 - F\left(\pi^{L,*}\left(D\right)\right)\right) = \frac{K_{0+}}{K}. \tag{38}$$

Since $\mu^H + \mu^L = 1$, it follows that (38) can be re-arranged to

$$\pi^{L,*}\left(D\right) = F^{-1}\left(1 - \frac{K_{0+}}{K}\right) \tag{39}$$

Combining with (33) leads to (35). $\qquad \square$

Remark 2. *The assumptions that the initial fractions of H (resp. L) regime firms are $\mu^H = \frac{p^H}{p^H + p^L}$ and $\mu^L = \frac{p^L}{p^H + p^L}$ are for technical convenience. They ensure that the initial and long-run values of of H, and L firms coincide, so that we don't have to study the differential equations associated with the transition to the steady state. Similarly, assumption (34) ensures that the selection of firms at the onset of the crisis does not distort the initial fractions from their steady state values. The benefit of these assumptions is that D (and the fraction of projects in the H and L regimes) remain constant throughout the crisis.*

Assuming that $r + \rho - p^H\left(\frac{1}{C} - 1\right) > 0$, Proposition 5 implies that D, which governs the opportunity cost of funding a dollar, increases as the capital remaning in the country, K_0^+ decreases.

Now assume that some competitive, specialized lenders have the ability to accumulate capital (pre-crisis) so as to poach loans at the onset of the crisis. For simplicity, assume that they can borrow at the rate R and invest at the rate $R^I < R$ prior to the crisis. Then the equilibrium amount of capital ΔK_{0+} that these capital providers will choose to accumulate

is given by the condition

$$\underbrace{R^I}_{\text{Liquid investment return}} + \underbrace{\rho^C \left(\frac{D\left(K_{0+} + \Delta K_{0+}\right)}{C} - 1 \right)}_{\text{expected rents from poaching an } H-\text{firm}} = R. \tag{40}$$

Combining (40) with (39) leads to

$$\Delta K_{0+} = \max \left\{ 0, K - K_{0+} - KF\left(\pi^{L,*}\left(C + C\frac{R - R^I}{\rho^C} \right) \right) \right\}$$

where $\pi^{L,*}$ is given by (33).

The implication of (40) is that $\frac{D\left(K_{0+} + \Delta K_{0+}\right)}{C} > 1$ as long as $R > R^I$. Therefore, the amount of capital ΔK_{0+} that is accumulated by the specialized lenders falls short of eliminating rents, since these speciallized lenders need to be compensated for the (negative) return differential $R^I - R$ that they incur in the pre-crisis state of the economy.