Cross-subsidization of Bad Credit in a Lending Crisis*

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Abstract

We study the corporate-loan pricing decisions of a major Greek bank during the Greek financial crisis. A unique aspect of our dataset is that we observe both the interest rate and the "breakeven rate" of each loan, as computed by the bank's own loan-pricing department (in effect, the loan's marginal cost). We document low-breakeven-rate (safer) borrowers are charged significant markups, whereas high-breakeven-rate (riskier) borrowers are charged small and sometimes even negative markups. We rationalize this de-facto cross-subsidization of riskier borrowers by safer borrowers 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. The concern can be summarized as follows: banks may be reluctant to terminate loans, because of depressed collateral values. As a result, worse-performing firms are charged interest rates below a "fair rate" in order to keep these firms "afloat." In an effort to make up the losses, banks overcharge healthy and growing firms that don't 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. Such a determination requires knowledge of the "fair" or "breakeven" rate for that loan. 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 the borrower's probability of default times the expected loss upon default (taking into account collateral) and any regulatory charges associated with the loan. In effect, the breakeven rate is the marginal cost of the loan from the lender's perspective. To address this limitation, the literature typically imputes the breakeven 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, by using a dataset that contains loan-level breakeven rates. The dataset pertains to the large corporate portfolio of a major Greek bank at the height of the recent Greek financial crisis. The *unique* aspect of the dataset is that besides loan-level information (actual interest rate, maturity) and firm-level information, we also observe the loan-level *breakeven rate* that the bank's own loan-pricing department supplies to the loan managers ahead of the loan negotiations. This allows a direct observation of the difference between the actual and breakeven rate, which we refer to as the "markup" of each loan.

Our main finding is that the bank charges an interest rate well above the breakeven

[1] We summarize some indirect approaches in our discussion of the literature.

rate to comparatively safe borrowers (low-breakeven-rate borrowers). By contrast, the bank charges a zero, and sometimes even negative, markup to its riskier loans (high-breakeven-rate borrowers). Importantly, because the loans in our sample are performing loans, we are able to show that thepattern of cross-subsidization applies even *within* the set of performing loans, and our conclusions are not confined to a narrow comparison *between* performing and non-performing loans.

We next describe in greater detail the theoretical motivation behind our tests, the context of our empirical analysis, and our key findings.

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" regime. In the post-crisis regime, the bank has friction-less access to capital markets and the collateral values of capital are high enough that terminating low profitability borrowers is profitable. By contrast, when the economy is in a crisis, we assume (a) the bank loses its frictionless access to capital markets and has limited or no access to new capital and (b) the collateral values of capital are temporarily depressed.

We show loan pricing differs for low-profitability and high-profitability borrowers. The interest rate for low-profitability borrowers is disconnected — and may even be lower than — the loan's marginal cost, because of the real option to wait until either collateral values rebound or the firm productivity rebounds. 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 markup, up to the point where competitor banks are indifferent between poaching the loan or not ("limit pricing").

The theoretical model makes two 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. (We label this prediction an imperfect "pass through" of the breakeven rate to the actual rate.[2]) Second, pass through 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 predictions using a dataset that includes the universe of large-firm loans of a major, systemic bank in Greece. We exploit a regulatory reform in the Greek banking system that required financial institutions to develop new, transparent loan-level pricing guidelines. The requirement was imposed by the the monitoring institutions of the Greek MoU (Memorandum of Understanding) 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., reflect balance-sheet information rather than subjective assessments), 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. The ultimate output should be a *loan-level* breakeven rate, defined as the interest rate that makes the bank break even on the loan. The new pricing model went into effect in 2015, approximately two quarters before the peak of the Greek financial crisis. Importantly, after the introduction of the new pricing guidelines, loans extended with interest rates below the breakeven rate required internal approval that stated the justification for the discount.

The introduction of the new pricing guidelines has a profound impact on loan pricing. Loan managers heed the new guidelines and start "passing through" the breakeven rates to the loans that are initiated or renewed. Indeed, the breakeven rate appears to be the only variable that matters for loan pricing after the introduction of the new pricing guidelines. This finding is in contrast to the pre-guideline period, where the (ex-post calculated) breakeven rate plays no role for loan pricing. At the same time, variables capturing non-economic factors (political connections of board members, dummy variables that indicate a

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

tightly held firm, etc.) seem to matter for loan pricing during the pre-guideline period, but are driven out post-guideline.

Having established that the new pricing guidelines weren't simply ignored, but instead had a profound impact on loan pricing, we test for imperfect pass-through of the breakeven on the actual rate after the introduction of the new pricing guidelines. Consistent with our model, the coefficient of a regression of the actual rate on the breakeven rate is always below one, implying markups are decreasing in the breakeven rate. This finding is pervasive. We even observe several instances in which loans are extended at below-breakeven rates, with loan managers choosing to go through the arduous internal-approval process.

We also document a pricing asymmetry. The pass-through coefficient (controlling for time and firm fixed effects) is about 0.4 for relatively safe borrowers (borrowers with below-median break-even rates on the date of the introduction of the new pricing guidelines). The same coefficient is essentially 0 for relatively risky borrowers (borrowers with above-median break-even rates on the date of the introduction of the new pricing scheme). This finding is consistent with the view that the pricing decisions for the riskier borrowers are decoupled from the riskiness of their loan. Instead, they are mostly dictated by the borrower's ability to pay, consistent with our theoretical model.

Next, we examine possible alternative interpretations of our results. We investigate whether the source of the imperfect pass-through is due to managers' possessing some superior information on the long-term prospects of the firm, which induces them to moderate the impact of the breakeven rate on their loan-pricing decisions. Utilizing a test analogous to Chiappori & Salanie (2000), we test 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 breakeven rate on their loan-pricing decisions. Our results are also not driven by loan managers choosing to pass through only the component of the breakeven rate that is narrowly linked with the regulatory charge of the loan. Isolating the component of the breakeven rate that corresponds to the regulatory charge of each loan, and including it as a separate regressor (alongside the breakeven rate) does not change our results.

Our results relate to several strands of the literature. The literature on zombie lending (Peek & Rosengren (2005); Caballero, Hoshi & Kashyap (2008); Giannetti & Simonov (2013)) has examined the widespread practice by Japanese banks in the 90s to provide credit to insolvent firms. Much of the literature shifted its focus to Europe during the sovereign debt crisis (Acharya, Imbierowicz, Steffen & Teichmann (2020); Acharya, Eisert, Eufinger & Hirsch (2019); Acharya, Crosignani, Eisert & Eufinger (2020); Schivardi, Sette & Tabellini (2021); Blattner, Farinha & Rebelo (2019); Banerjee & Hofmann (2018); McGowan, Andrews & Millot (2018); Albertazzi & Marchetti (2010)). In a contemporaneous paper, Faria-e Castro, Paul & Sanchéz (2021) provide evidence of "evergreening" in the US using supervisory data from the Federal Reserve. As mentioned earlier, our dataset allows for a direct test of the cross-subsidization hypothesis, without having to rely on some indirect inference for the "fair" (or "breakeven") rate of each loan.[3] In addition, although related to the literature on zombie lending, our paper is not just about zombie loans. Because we can observe the markup of each loan, we are able to document a broader pattern of cross-subsidization of riskier borrowers by safer borrowers *across performing loans*.

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 passthrough 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 in that it pertains to *knowingly* charging different markups to clients

[3] Prior research on zombie firms examined interest coverage ratio, credit rating, delinquency, unreported loss, and accounting variables to ascertain whether a bank subsidized a given firm.

who are *observably* dissimilar (as reflected in their different breakeven rates), as opposed to the cross-subsidization that arises when borrowers who are observably *similar* (but dissimilar on unobservables) are *pooled* together and charged the same price.

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.[4] Second, in such models, the markup is typically positive across all credit qualities,[5] whereas in our data, we observe several instances in which loan managers extend loans at below-breakeven rates, hinting at the presence of a "real option." Third, as mentioned earlier, in section 7.1, we perform a test similar in spirit to the asymmetric-information test of Chiappori & Salanie (2000)[6] and find that the actual interest rate on a loan does not appear to have superior ex-post predictive ability about a borrower's future prospects.

Due to its dynamic nature, our model resembles the large banking literature on relationship lending.[7] 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 (Acharya, Drechsler & Schnabl (2014); Acharya, Eisert, Eufinger & Hirsch (2018); Acharya, Imbierowicz, Steffen & Teichmann (2020)). Several articles examine the relationship between bank market power and interest rate pass through (Hannan & Berger (1991); Berger & Udell (1992); Neumark & Sharpe (1992); Zentefis (2019)). For instance, Scharfstein

[4]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 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.

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

[6]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.

[7]See, for example, Diamond (1991); Rajan (1992); Petersen & Rajan (1994); Boot & Thakor (2000); Hachem (2011).

& Sunderam (2016) show how bank market power can limit monetary-policy transmission to mortgage rates. The notion of limited pass-through in these papers is different from that in our paper. For us, limited pass-through is primarily a cross-sectional notion: 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. The model contains several elements that are meant to capture the specific economic context of Greek banks and borrowers during the time period of our study. Although a few of the modelling choices are motivated by the specific historical experience of Greece, the assumptions of the model are standard and would apply to any banking system in crisis.

In particular, 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." Our focus is on the state of crisis. We make three assumptions about the crisis, motivated by the circumstances Greek firms and banks faced during our sample period: (a) Greek banks had limited access to international capital markets, (b) collateral values of all projects were depressed during this time period, and (c) shareholders had essentially no ability to perform equity injections.

To fix ideas, 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. Specifically, we assume that 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 arrival of this event occurs with a hazard rate ρ per unit of time dt. Throughout, superscript "c" denotes a variable during the state of crisis.

2.1 Post crisis

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.[8] 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 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 parameters p_i^H, p_i^L, π_i^H,and π_i^L.

While keeping in mind that the parameters p_i^H, p_i^L, π_i^H, and π_i^L can differ across firms, hereafter, we drop the subscript i and use the simpler notation p^H, p^L, π^H, and π^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. To economize notation, we drop the subscript i and write R^j and C instead of R_i^j and C_i (respectively).

Throughout, we abstract from corporate cash accumulation by assuming shareholders have a sufficiently high discount rate λ.[9] 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 in the full amount 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

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

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

contract is

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

Similarly, the pricing equation when the firm is in regime L is

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

Because banks are competitive, it must be the case that both $V^H \leq 1$ and $V^L \leq 1$. Otherwise, a competitor bank can offer to refinance the loan, whose face value is 1. 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, the bank can feasibly 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

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

Further, 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,*

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

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 Crisis

The focus of our analysis is on the state of crisis. The crisis-version of the model is identical to the post-crisis version, except that: (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 limited 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^*).

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

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

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

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

Clearly, a bank will not find it profitable to liquidate a loan as long as $V^{L,c} \geq C$.

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 $\frac{1}{C}$ of its existing loans, so that it can raise the face value of the loan it is poaching, $\frac{1}{C}C = 1$. 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 $V^{L,c}$ across all debt contracts that the rival bank is financing. (The heterogeneity of the parameters p^H, p^L, π^H, π^L, etc. across firms implies $V^{H,c}$ and $V^{L,c}$ differ across firms). Because $V^{L,c} \geq C$ for any debt contract of any bank, it must be the case that $\frac{D}{C} \geq 1$.

In summary, unlike in the post-crisis regime, 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*

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

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*

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

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 during a crisis, liquidating the firm in regime L is not optimal. The intuition is that the low collateral values during the crisis act as a disincentive for liquidations. Hence, firms that would get liquidated in the post-crisis state survive during a 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 in the simplest possible way, assume $r = r^*$. 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 reason is that the difficulty of rival banks to raise new capital becomes a de-facto impediment to competition between banks.

The shareholders of firms in the L regime benefit during a crisis. In post-crisis times, the firm gets liquidated and these shareholders receive nothing. By contrast, during the crisis, the firm stays alive in the L regime. Although the bank appropriates all cash flows while the firm is in the L regime $\left(R^{L,c} = \pi^L\right)$, 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.

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.

We conclude this section with a parenthetical remark: While in our baseline model we have treated the population of firms as fixed, an extension of the model to allow for firm entry would readily imply that new firm creation is impeded when the economy is in a crisis. Since banks earn rents on their loans to high-profitability firms, this means that a smaller surplus would be left for aspiring entrepreneurs, who could create firms that start out in the H regime and have to rely on bank financing. Accordingly, firm-creation incentives would be weaker, along with aggregate investment and growth.

2.3 Empirical implications

The next proposition contains a testable prediction of the model:

Proposition 3. *During the crisis state,*

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

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, $\rho\,(1 - C^{*})$ — 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

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

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

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

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.[10,11] We refer to this model prediction as the "limited pass-through" hypothesis and test it 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, 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. By contrast, in the L regime, the pricing of a loan is determined exclusively

[10] 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.

[11] 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.

by a borrower's ability to pay, $R_i^{L,c} = \pi^L$.

To show the empirical implications of this asymmetry, one 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 jumps up for that borrower). According to (13), this change will increase $R^{H,c}$.[12] It will also increase the probability of default of a loan that is extended over a discrete interval of time.[13] 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 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, $R_i^{L,c} = \pi^L$). This implies a zero covariance between interest rates and the discrete-interval probability of default for firms in the L-regime. This "asymmetric" pass-through implication is an additional feature of the model and we test it in section 6.

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 climbed higher than 1,000 basis points (bps), thus (de facto) excluding the country from international markets.

[12] 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 $V^{H,c}, V^{L,c}$.

[13] 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.

The recovery process was particularly prolonged and required three ecomomic adjustment programs (Memorandum of Understanding (MoU))—in 2010, 2012 and 2015. Figure 1 plots Greece's (real) gdp growth rate and compares it with Cyprus, Italy, Portugal, and Spain (CIPS) over the period covered by our data set. The main political event, the election of the anti-austerity party of Syriza, is depicted with a dotted line. Figure 1 shows that Greece experiences negative, or very weak, positive growth rates for essentially our entire sample period. Unlike the other CIPS countries, Greece did not experience a recovery from 2014 onwards.

The crisis had an acute impact on the banking sector, which has always played a central role in the Greek financial system.[14] The crisis exposed long-term weaknesses of the banking sector, including the over-exposure to Greek government bonds. The "private sector involvment" (PSI) restructuring program and the significant "haircut" on Greek bonds in 2012 led to the first recapitalization of the four major ("systemic") 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.[15] 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

[14] For an excellent review of the Greek financial system during the period of the Greek crisis, see Haliassos, Hardouvelis, Tsoutsoura & Vayanos (2017).

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

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, no systematic, data-driven, and model-based determination of the marginal cost of a loan (the breakeven rate) was in place that bank managers had to charge, leaving significant room for discretion.

Following the PSI, which led to a significant "haircut" on Greek bonds and the inevitable recapitalization of Greek banks in 2012, the monitoring trustees[16] required the development and use of uniform, data-driven, pricing models for credit products. 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 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 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 firms 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. The bank uses long-term predictions for these costs; therefore, these components do not vary either in the cross-section or the times-series dimension in our sample. 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

[16] 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.

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 - CRR), adjusted by a hurdle rate. Note that all the inputs into the credit-risk cost are based on models, which in turn use company balance-sheet data as inputs.

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 breakeven 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 are free to offer rates higher than the breakeven rate to their borrowers. But if the actual rate is lower than the breakeven rate, the monitoring trustee requires internal approval at the highest level, which states the reason for the discount.

3.3 Data

Our analysis combines several proprietary datasets from a large Greek bank, which we combine 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, and includes some of the largest (top 5% in terms of assets and sales) and most established firms in Greece. Figure 2 reports the distribution of log(assets) for the 150 firms that constitute our sample as well as the universe of Greek firms covered by Amadeus van

Dijk database in 2014.[17] As is evident from the graph, our sample covers the largest firms in Greece.

We focus on term loans and credit lines, and our sample period extends from January 2015 to June 2017. In section 4, we also extend our dataset back to January 2013 to study the pricing practices of the bank prior to the introduction of the new loan-pricing guidelines.

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. We also observe the values of the components of the breakeven 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 in section 3.2, loans that are priced below the breakeven rate require special approval and a justification for the discount. In a separate file, we observe all the internal-approval decisions for loans priced below the breakeven rate, along with the provided explanations for the discount. These justifications are qualitative, but a discrete number of categories exist that each justification can fall into.

Moreover, we observe the performance of past and new loans of every firm at a monthly frequency. The data contain information on monthly payments, amounts outstanding, credit-line utilization, credit scores, past-due days, and the borrower's status. 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 theaverage actual interest rate and breakeven interest rate in our sample are 5.4% and 4.8%, respectively, implying an average markup (which we define as the difference between actual and breakeven interest rate) of 62 bps. Remarkable differences exist in the markups charged to different loans. At the 5th percentile, the markup is significantly

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

negative (-3.57%), whereas it is very large at the top 95th percentile (4.46%).

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 (standard deviation of 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. (This feature of the data is what motivated us to abstract from long-term debt contracts in our model and instead focus on continuously rolled-over loans). The majority of the loans are collateralized (85% of the loans have collateral.) In the Appendix (Tables A3 and A4), we provide the summary statistics for term loans and credit line products separately.

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 liabilities equalling 51% of their assets.

4 Introduction of the New Pricing Guidelines

In this section, we ask two questions. First, did the adoption of the new pricing guidelines have a material impact on the interest rates faced by borrowers? And second, did the variables that matter for the loan-pricing decisions change after the new pricing framework was enacted?

We start by showing that the adoption of the new pricing guidelines 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 breakeven interest rate.

Figure 3 presents the average interest rate charged on new loans for each of the three groups by month over our entire sample. The graph illustrates a discrete change in the actual interest rates charged to the three groups upon the introduction of the new pricing guidelines. First, we observe that prior to the enactment of the new pricing guidelines, no major differences exist in the interest rates charged to the three groups. Thereafter, a visible divergence occurs across the three groups, with high-breakeven-rate borrowers facing substantially higher interest rates, borrowers in the middle group showing no appreciable change, and borrowers in the low-break-even-rate group obtaining somewhat lower interest rates than before. Interestingly, during the two turbulent months surrounding the imposition of capital controls (mid-2015), we find that interest rates across all three groups temporarily converge back together. This observation suggests that at the time when the Greek financial crisis reaches its climax,[18] evidence shows that the pricing model is de-facto temporarily suspended. However, this phenomenon only lasts until Greece signs a new MoU with its creditors. Thereafter, the differences between the three groups revert to the levels seen around the introduction of the new pricing guidelines.

To further study the effect of the introduction of the new pricing guidelines in 2015, we restrict our sample to borrowers who sign a new loan contract with the bank both in the year prior to the introduction of the new pricing guidelines and in the year of the introduction, to account for any changes in sample composition between those two years.[19] In Figure 4, we report the distribution of the *change* in each borrower's interest rate between the year before and after the introduction of the new pricing guidelines. We then plot the distribution of these differences by initial-breakeven-rate group. We find these distributions indeed appear different for the three groups. The borrowers in the low-initial-breakeven-rate bin receive a favorable adjustment to their interest rate (1.08% decrease on average), whereas the high initial-breakeven-rate borrowers receive an unfavorable adjustment (1.86% increase on average). On average, the medium-initial-breakeven-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.

[18]During those two months, the financial situation of the country can be fairly described as bordering on chaotic, with banks imposing strict withdrawal limits on individuals and international capital flows permitted only for absolutely necessary, trade-related reasons. Especially during the few weeks between the referendum of June 2015 and the signing of the new MoU with the monitoring institutions, whether Greece was going to remain in the Eurozone was unclear.

[19]We treat renewals of old loans as new loan contracts, because the bank does not distinguish between them and assigns a new loan identification number, reflecting that a loan renewal is a new legal contract.

Additionally, we perform a regression analysis to test the relationship between a borrower's initial breakeven rate and the change in their actual interest rate on new loans. Similar to Figure 4, the sample consists of borrowers who sign a new loan contract with the bank both in the years pre- and post-guideline introduction. Specifically, we estimate the following specification:

$$\Delta \mathit{Actual\ Rate}_{i,2015} = \alpha_s + \beta(\mathit{Breakeven}_{i,2015} - \mathit{Actual\ Rate}_{i,2014}) + \delta\Delta X_{i,2015} + \varepsilon_i, \quad (18)$$

where $\mathit{Actual\ Rate}_{i,t}$ is the average interest rate for new loans in year t for borrower i (and $\Delta\mathit{Actual\ Rate}_{i,2015}$ is the difference between the average interest rate in years 2015 and 2014 for that borrower), $\mathit{Breakeven}_{i,2015}$ is the average breakeven rate for borrower i in the year 2015, α_s are industry fixed effects, and $\Delta X_{i,2015}$ are first differences in some borrower controls. Intuitively, we regress the change in the borrower's interest rate from 2014 to 2015 on the difference between the borrower's 2014 interest rate and their initial breakeven rate prescribed in 2015. The coefficient of interest β captures how many basis points the actual rate of the borrower moves, for a 1 bps difference between the initial breakeven rate and the actual rate in 2014.

We also report results for a similar specification, using an adjustment model with "inertia":

$$\mathit{Actual\ Rate}_{i,2015} = \alpha_s + \beta\mathit{Breakeven}_{i,2015} + \rho\mathit{Actual\ Rate}_{i,2014} + X_{i,2015}\delta + \varepsilon_i. \quad (19)$$

We note specification (19) nests (18) as a special case, when $\rho = 1 - \beta$.[20]

Table 2 presents the results of equations (18) (Panel A) and (19) (Panel B). It 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 1% discrepancy between the initial breakeven 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

[20] This follows from $\Delta\mathit{Actual\ Rate}_{i,2015} = \mathit{Actual\ Rate}_{i,2015} - \mathit{Actual\ Rate}_{i,2014}$.

equation (19) 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 breakeven rate according to the bank's model, we can compute what the breakeven 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 3 and Figure A2 (in the appendix) show that the (ex-post calculated) breakeven rate plays essentially no role in loan-pricing decisions prior to the enactment of the new pricing guidelines, but plays a dominant role thereafter.

Figure A2 provides a visual illustration, by showing a scatter plot of actual and breakeven rates for the four quarters prior to the introduction of the new pricing guidelines and the four quarters after. The figure shows essentially no relation between the breakeven rate and the actual rate prior to the introduction of the new pricing guidelines and a clear positive relation after. In the next section, we examine this positive relation in greater detail.

Table 3 formalizes this visual impression in a regression framework. The table shows that by creating a transparent, loan-level measure of marginal cost, the new pricing guidelines mitigated non-economic influences on loan pricing. To illustrate, we use various data on board characteristics of the firms in our sample, which are described in the Appendix (Table A1). These board characteristics are intended to capture political and media affiliations of board members, and tightly-held family firms (which would indicate a higher likelihood of personal connections), and so on. We then run regressions of actual loan rates on the respective breakeven rates (which we calculate ex-post for 2013 and 2014) along with variables reflecting board characteristics. We contrast the data prior to the enactment of the new pricing guidelines and thereafter. Because we have several variables on board characteristics, we run a lasso regression to determine which variables have explanatory power before and after the enactment.

Table 3 reports the results of OLS and lasso regressions. Column (1) of Table 3 shows that the (ex-post calculated) breakeven rate cannot explain the actual interest rate during the pre-guideline period. Meanwhile, many board-characteristic variables (e.g., having the firm founder on the board, or having a board member with political affiliations) are statistically significant for explaining the actual interest rate during the pre-guideline period. Furthermore, column (2) shows that most of the board-characteristic variables are included in the restrictive set of covariates selected by the lasso regression. For example, variables such as "politician on board" or "media executive on board" appear important during the pre-guideline period. Columns (3) and (4) show a drastic change after the enactment of the new pricing guidelines. Specifically, column (3) shows that thebreakeven rate is one of only two variables with statistical significance in the full-covariate OLS specification. Interestingly, we find that the breakeven rate is the only variable selected by the Lasso regression in column (4), suggesting that after the adoption of the new pricing guidelines, the board-characteristic variables lose their ability to predict the actual interest rate charged on loans. This stark contrast illustrates that the new pricing guidelines reduced the discretion that was afforded to loan managers by the lack of a transparent, loan-level breakeven rate.

In summary, this section showed that the introduction of the new pricing guidelines had a material impact on loan pricing. By creating a transparent, loan-level measure of marginal cost, the new guidelines appear to have mitigated non-economic influences on loan-pricing decisions. Table 3 suggests that the board variables that seemed to play a role during the pre-guideline period for the determination of loan rates appear to play no role thereafter.

The next section focuses on the post-guideline period and shows that although the new pricing guidelines had a material impact on loan negotiations, the regression coefficient ("pass through") from breakeven rates to actual rates is far below one.

5 Limited "Pass Through"

In this section, we test the cross-sectional implications of Proposition 3. We focus on the dates after the implementation of the new pricing guidelines and investigate one of the key predictions of our model, namely, that less than a one-for-one "pass through" exists from the breakeven rate to the actual rate. Phrased in a mathematically equivalent way, we test whether the "markup" (the difference between the actual and breakeven interest rate) is a decreasing function of the breakeven rate.

Figure 5 provides a first illustration of the relation between the breakeven and actual rate for all loans initiated during the post-guideline period. An observation above the 45° line indicates a loan priced above its breakeven rate, whereas an observation below the 45° line indicates a loan priced below its breakeven rate. Some observations have the same x-value, because the borrower's credit rating, which is an input into the pricing equation, takes discrete values.

A few observations about Figure 5 are noteworthy. First, the large majority of the observations are above the 45° degree line, consistent with the pricing guidelines provided to the loan managers. Additionally a small, but non-trivial number of loans receive actual rates below the breakeven rate, even though such loans are scrutinized and require internal approval, as we discuss in greater detail in section 7.3. The slope of the regression line relating actual and breakeven rates is substantially less than one, implying that the markup (the difference between the actual and breakeven rate) is a declining function of the breakeven rate.

To gauge the statistical significance of the pattern illustrated in Figure 5 and to control for covariates, we estimate the following OLS specification:

$$Actual\,Rate_{imt} = \alpha_t + \alpha_s + \beta\,Breakeven\,Rate_{imt} + X_{it}\delta + X_m\eta + \varepsilon_{imt}, \tag{20}$$

where $Actual\,Rate_{imt}$ corresponds to the interest rate issued to loan m of borrower i, and 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 $Breakeven\,Rate$, which represents the cross-sectional pass-through of the breakeven interest rate, is our main estimate of interest. Specifically, values below one signify that each percentage increase in the breakeven rate results in a less than one-for-one pass-through to the actual interest rate.

We report our baseline estimates of equation (20) in Table 4. The estimated β coefficient of the breakeven rate in column (1) is roughly 0.3, meaning a 1% increase in the breakeven 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) 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 breakeven rate essentially unchanged. In particular, controlling for the breakeven rate, firm-performance indicators such as OROA, or the ratio of Assets-to-Liabilities do not play a significant role.

Column (6) augments equation (20) with firm fixed effects and shows that the pass-through from breakeven to actual interest rate is significantly reduced once we account for firm-fixed effects. We postpone a detailed discussion of this finding until section 6.

Table 5 revisits the regressions of Table 4 but including a control for a 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 breakeven 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 in our baseline specifications, 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.

Finally, we find similar results for all the above tests when we separate the sample into term loans and credit lines, which we report in the Appendix Tables A5 and A6.

6 Asymmetric Pass-Through at the Borrower Level

In this section, we test the model's mechanism in greater detail. As we noted at the end of section 2.3, one important aspect of our model is that once a firm is in the low-profitability regime, the bank extracts all free cash flow. In this regime, the only determinant of the firm's interest rate is the firm's *ability* to pay; the firm's probability of default becomes irrelevant. 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 firm's interest rate is positively related to the firm's default probability.

This feature of the model can help explain why the regression coefficient in equation (20) decreases significantly when we include firm fixed effects in the regression. To explain why, we re-estimate equation (20) including both time and firm fixed effects, but we split the sample into two subsamples: the first (second) subsample includes firms whose initial breakeven 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 language of our model.

Table 6 reports an interesting asymmetry. Columns 3 and 4 show that the firms with high initial breakeven rates (risky creditors) exhibit essentially no pass-through after controlling for time and firm fixed effects.

By contrast, the firms with a below-median breakeven rate (safer creditors) 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 breakeven rate, interest rates are dictated by factors such as the borrower's ability to pay, rather than the breakeven cost of the loan – consistent with the predictions of the theoretical model.

Because the pass-through coefficient is essentially zero for below-break-even-rate borrowers, the pass-through coefficient for the entire sample becomes very small once we control for both time and firm fixed effects.

The results of the previous and the current section can be summarized as follows. Upon introduction of the new pricing guidelines, we observe a noticeable adjustment of loan rates in response to the newly introduced breakeven rates. Thereafter, borrower-level changes to the breakeven rate do not seem to pass through to the borrower's actual rate. However, this muted pass-through (after including firm fixed effects) is driven by firms with high initial breakeven rates. This finding is consistent with the view that (a) the ability of the bank 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 borrowers who start out with high initial breakeven rates. Given that these borrowers are more likely to be in a regime where this constraint is binding, incremental variations to their breakeven rate are irrelevant for the determination of their actual interest rate.

7 Discussion and Robustness

7.1 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, thus choosing to not fully pass through the breakeven rate to their borrowers. For example, loan managers may choose to ignore an increase in the breakeven 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)[21] is that when the loan managers charge an interest rate below the breakeven rate, this decision should predict an improvement in the firm's future creditworthiness.

In this section, we investigate whether the difference between actual and breakeven rate has predictive power for the future prospects of a firm. To test this alternative hypothesis, we use the borrower "rating" as a dependent variable. The borrower "rating" has a one-to-one correspondence with the borrower's probability of default, which in turn is the 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 for each borrower, irrespective of whether the borrower initiates a new loan contract in a given month.

We run the following regression:

$$Rating_{i,t+h} = \alpha_t + \alpha_s + \phi\, Diff_{i,t} + \theta\, Rating_{i,t} + \varepsilon_{i,t}, \tag{21}$$

where $Rating_{i,t+h}$ corresponds to the rating of borrower i in month $t+h$, and $Diff_{i,t}$ is borrower's i difference between the actual interest rate minus the breakeven interest rate in month t.[22] We include time fixed effects, α_t, industry fixed effects, α_s, and include a control

[21] Chiappori & Salanie (2000) argue that a simple way to detect information asymmetries is by testing for correlation between ex-ante choices and ex-post outcomes.

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

for the credit rating, $Rating_{i,t}$, of borrower i in month t.

Column (1) of Table 7 presents the estimates of equation (21) using a horizon of 12 months ($h = 12$). It shows that – controlling for a borrower's current rating – $Diff$ has no predictive ability for the borrower's future credit rating. The coefficient ϕ for $Diff_{i,t}$ in (21) is both economically and statistically insignificant. This finding 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 differential between the actual and breakeven rate has no further predictive ability, after controlling for the current borrower rating. In columns (2) and (3), we present the results for samples that include only the borrowers with a negative (positive) difference between the actual and breakeven rate, respectively. In both cases, the regressions yield economically and statistically insignificant estimates for $Diff$. In fact, the coefficient of $Diff$ is mildly negative (positive) for below-breakeven (above-breakeven) rate borrowers, which suggests they become marginally worse rated (better rated) in the future. Furthermore, these results are robust to different choices of prediction horizon h.

We interpret these results as follows: loan managers, who set the actual interest rates in negotiation with the borrowers, do not seem to use foresight on future improvements (or worsening) of a firm's creditworthiness beyond what is already contained in the bank's pricing model.

An obvious caveat is that the short time-series dimension of our dataset limits the horizon for credit improvements to no more than two years.

7.2 Isolating the regulatory cost

Throughout the paper we have been interpreting the breakeven rate as a "marginal cost" to the bank. In determining this breakeven 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.[23] Whereas component (a) is not borrower-dependent, components (b) and (c) are.

One possible explanation for our results is that the loan managers de facto only treat

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

component (c) as the marginal cost of each loan. The reason is that — at least in the very short run — only component (c) directly affects the profits of the bank.

To the best of our understanding, loan managers are not provided with the decomposition of the total breakeven rate into its components, and their directions are to not extend loans below the breakeven rate. However, with experience, or informal communication within the bank, the loan managers may come to know, or form an educated guess of, the regulatory charge (c). 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 breakeven rate into its three components. Specifically, Table 8 reports results, when we include the regulatory charge as a separate regressor (alongside the breakeven rate). Table 8 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 loan managers adopting a more narrow view of the marginal cost of each loan.

7.3 Justifications for below-breakeven-rate loans

As described in section 3.2, the new pricing guidelines require loan managers to receive a separate approval in any situation where the interest rate charged on a loan is below the break-even rate. 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.[24]

A striking pattern in the data is that the magnitude of the breakeven rate is a very strong predictor of the provided qualitative justification. Figure 6 provides a visual illustration between discount justification, the breakeven 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 break-even rates, which receive the highest "discount." Similarly, loans with a breakeven rate in the middle range are generally approved for a discount by citing

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

the second reason (blue), and discounts for loans with the comparatively lower breakeven 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 estimate the regression

$$Justification = \alpha + \underset{(0.022)}{0.074}\, Breakeven\, Rate - \underset{(0.036)}{0.012}\, Discount + Quarter FE + \varepsilon, \quad (22)$$

where Justification takes the value 1,2,3, Discount refers to the difference between the actual and breakeven rate and the underset numbers in parentheses denote (robust) standard errors. The regression shows that the magnitude of the breakeven rate is a statistically significant predictor of the provided qualitative reason, whereas the magnitude of the discount is not.

One implication of regression (22) is that the qualitative justification cannot be just a reflection of the length and strength of the relation between the bank and the borrower: the length and strength of this relation is not input to the breakeven rate, and yet the magnitude of the breakeven rate seems to be the main driver behind the provided qualitative justification.

Our interpretation of (22) is that as the breakeven rate becomes higher, the loan managers become ever more cognizant of the borrower's inability to pay such high rates. Instead of passing through these high breakeven rates, they prefer to provide a larger discount, elevate the justification reason, and face higher scrutiny.

7.4 Borrower "stickiness"

One of the implications of the model is that during the crisis, the borrowers are not poached by other banks and the loans in the low profitability regime are not liquidated by the bank. Even though the bank may be making 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 and irrespective of whether or not the bank obtains rents from the loan.

Figures A3 and A4 provide some evidence that the frequency with which borrowers open new loans is not related to changes in the borrower-level breakeven rate or to the gap between the breakeven and actual rate.

In each color-coded figure, we sort the borrowers in our sample by how frequently they initiate or recycle loans. The most frequent borrowers are in the bottom rows, whereas the less frequent ones are at the top rows. A cell with a color indicates the borrower opened a new loan in that corresponding quarter. In Figure A3, the cells that are colored show whether the borrower experienced an upward revision in their breakeven rate between 2015 and 2016 (dark red), no revision (medium red), or downward revision (light red). In FigureA4, the colors show whether the borrower on average exhibits a difference between the actual and breakeven rate in the top tercile (dark red), medium tercile (medium red), or low tercile (light red).

The figures illustrate that no obvious relation exists between the frequency of negotiating new loans and the changes to the breakeven rate (Figure A3) or the magnitude of the markup (Figure A4). 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.

8 Conclusion

The monitoring institutions of the Greek bailout program mandated that Greek banks adopt objective, data-driven approaches for the computation of the cost of each loan (the breakeven rate of each loan). As a result of this mandate, we can observe both the actual rate of each loan and the breakeven rate that was computed by the bank's own loan-pricing department. Therefore, we can obtain a direct measure of the "markup" of each loan (the difference between actual and breakeven rate), sidestepping the notorious difficulties of inferring this markup when it is not directly observable.

We study the pricing patterns for new (and renewed) loans around the introduction of the new pricing guidelines that were mandated by the monitoring institutions. We document that the loan managers broadly heeded the new guidelines, as evidenced by significant changes in the pricing of loans around the enactment of the new pricing guidelines.

However, we also document a disconcerting pattern, whereby better-rated corporate borrowers are charged positive markups, whereas worse-rated corporate borrowers are charged small and on some occasions negative markups, despite the clear instructions to the loan managers to avoid negative markups. Thus, we can provide *direct* cross-sectional evidence of a de-facto cross-sectional subsidization of worse loans by better loans.

Controlling for firm fixed effects, and focusing on the pass-through of borrower-level variations of breakeven rates to actual rates, we document an interesting asymmetry. Changes in breakeven rates at the borrower level are passed through more strongly to better-rated borrowers than to worse-rated borrowers. Our interpretation is that for worse-rated borrowers, the ability of the borrower to pay (rather than the breakeven rate) is primarily what dictates the pricing decisions.

We find no evidence that the magnitude of the markup reflects superior information of the loan managers for the quality of the loans. The difference between actual and breakeven rates does not predict subsequent worsening or improvement of a borrower's credit rating.

We rationalize our main findings through the lens of a model. The model clarifies how the combination of (a) depressed collateral values and (b) the banks' limited access to capital markets during a crisis can lead to (i) limited competition between banks for the better borrowers and (ii) positive option values for maintaining worse borrowers, which can help justify the observed negative markups for the worse borrowers.

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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.

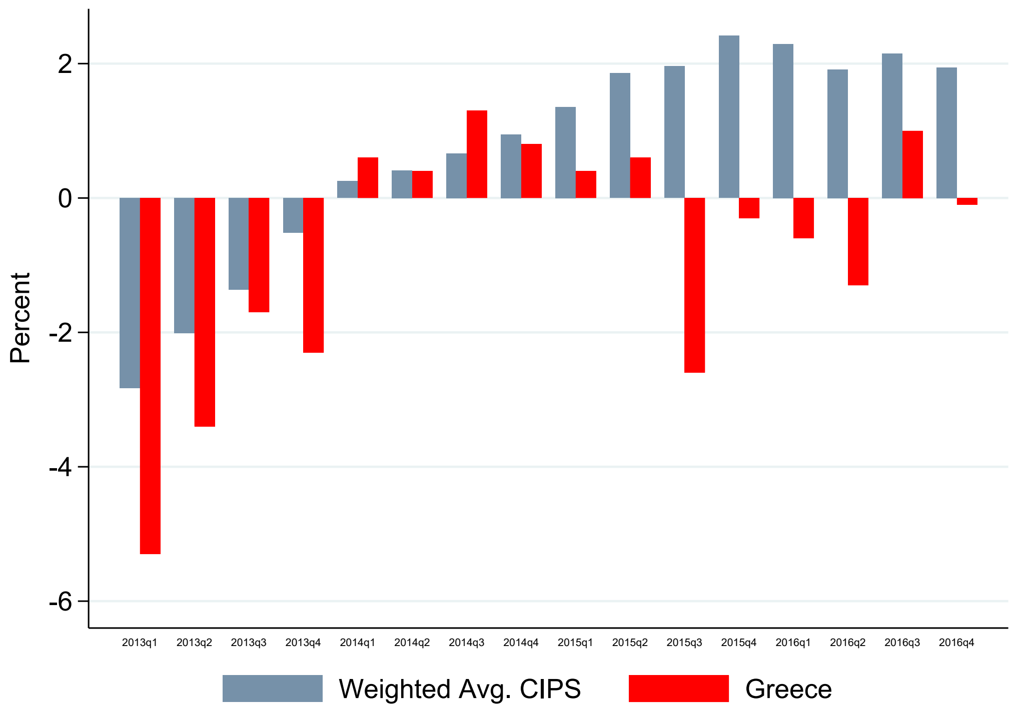


Figure 2: Sample distribution of log(Assets) vs. all Greek firms

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).

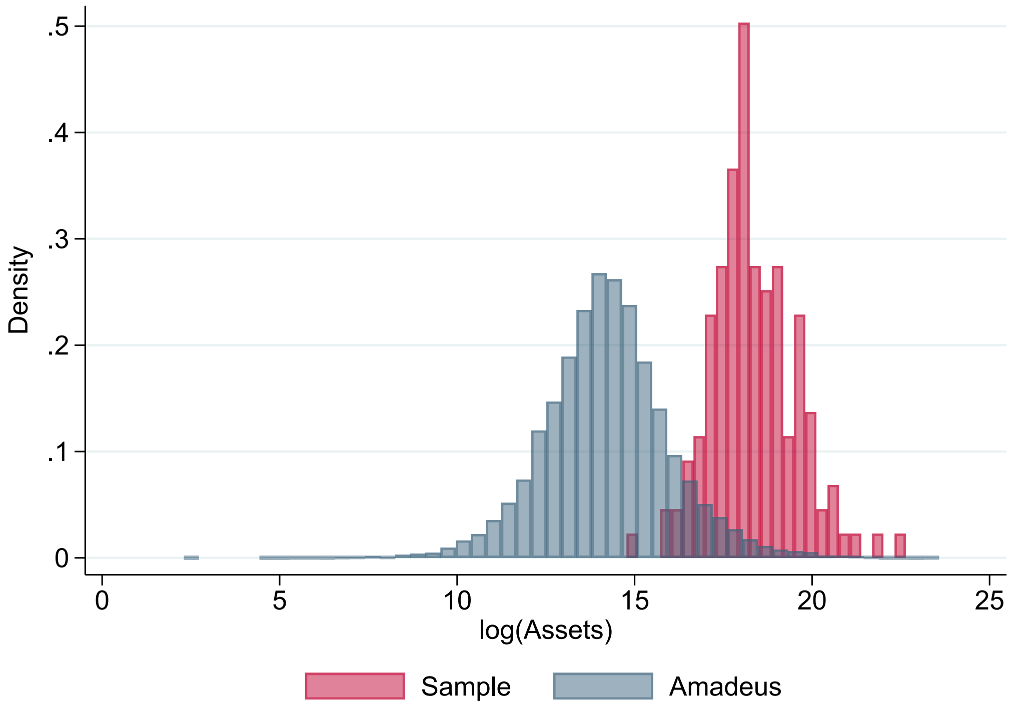


Figure 3: Time series of actual rates by initial breakeven rate

Corporate borrowers are divided into terciles according to each borrower's initially reported breakeven rate in 2015. Each series plots the average actual rate of the corresponding group in the month. The first vertical, dashed gray line denotes the beginning of 2015, and the second vertical, dashed gray line denotes the introduction of capital controls in June 2015.

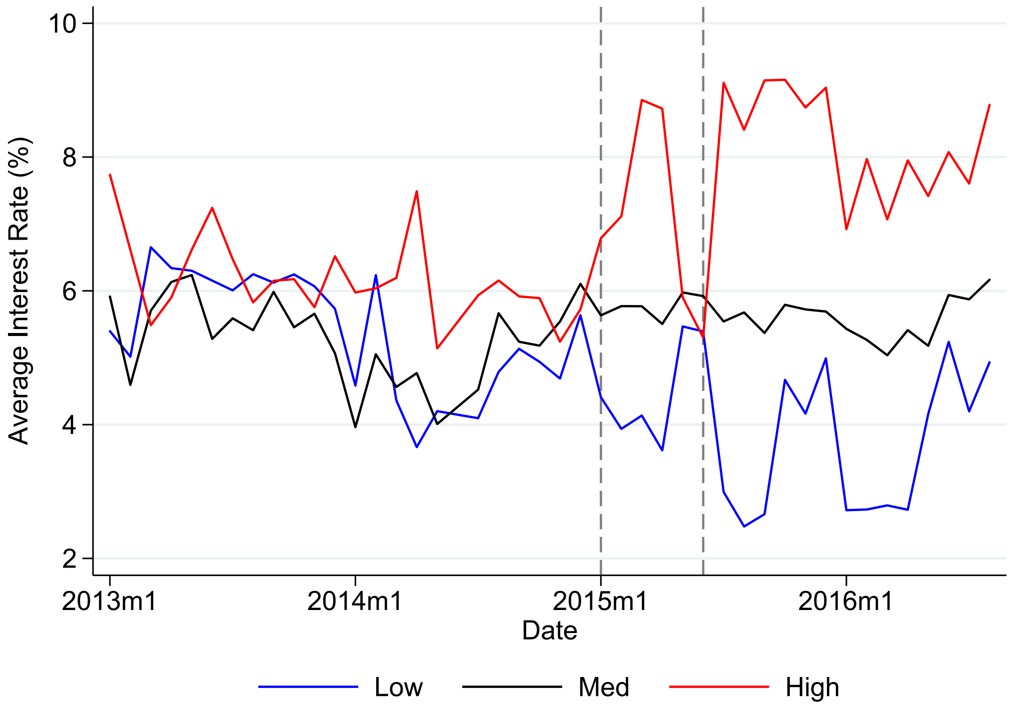


Figure 4: Actual rate changes by initial breakeven rate

These figures report the distribution of actual rate changes by initial breakeven rate. The sample is divided into three terciles, according to the initially reported breakeven 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 breakeven 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.

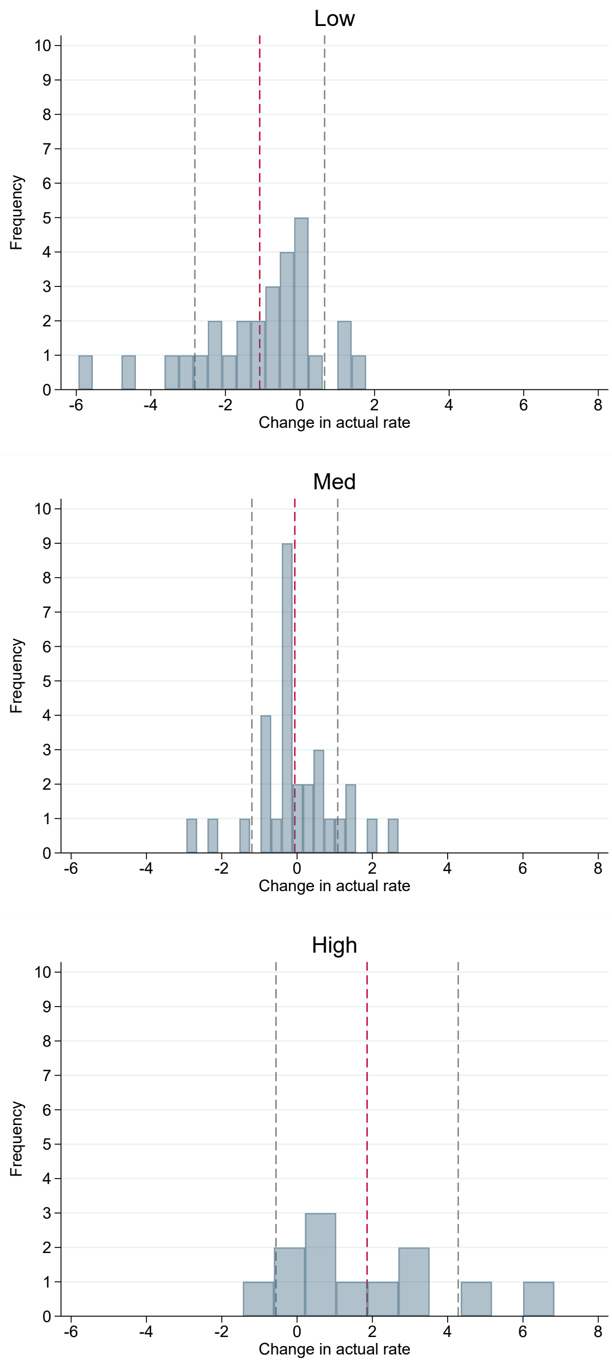


Figure 5: Actual rate and breakeven rate

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.

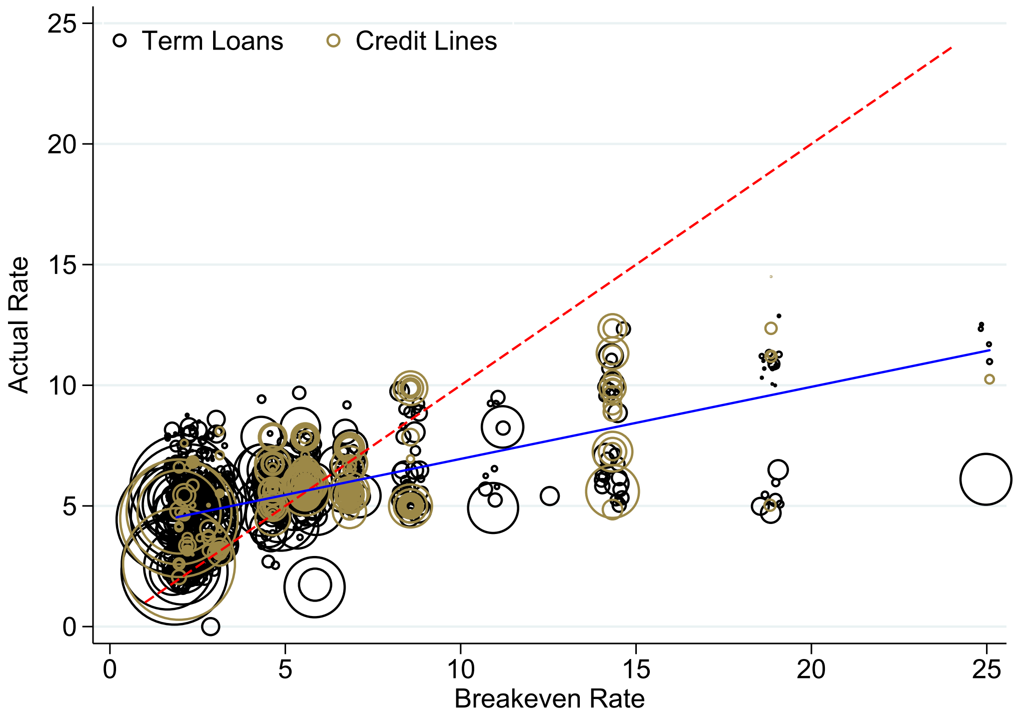


Figure 6: Reasons provided for below-breakeven-rate loans

Actual and breakeven rates of below-breakeven-rate loans, grouped by the cited discount reason. The red dashed line corresponds to the 45° line.

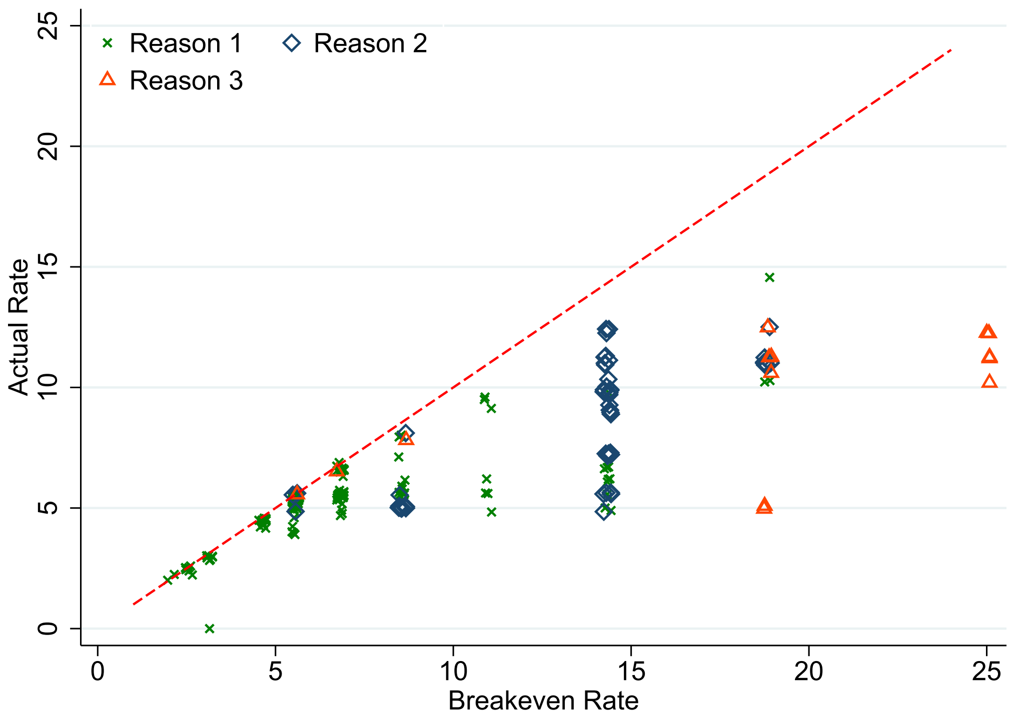


Table 1: Summary statistics

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
Dif (%)	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: Introduction of the new pricing guidelines and actual rate changes

This table reports the estimates of equation (18) in Panel A and equation (19) 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 breakeven 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 3: 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) and post-guideline period (Post-BE). 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 one. 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	0.025	-0.004	0.617***	0.663***
	(0.090)	(0.107)	(0.087)	(0.066)
OROA	0.016		-0.050	
	(0.094)		(0.058)	
Deposits	-0.015		-0.087	
	(0.134)		(0.088)	
Assets	-0.059	-0.120	0.073	
	(0.165)	(0.123)	(0.117)	
Liabilities/Assets	0.017	0.009	0.002	
	(0.082)	(0.083)	(0.069)	
Maturity	-0.031		-0.000	
	(0.030)		(0.024)	
Collateral	0.054	0.090	0.021	
	(0.068)	(0.060)	(0.042)	
founder on board	-0.290**	-0.168***	-0.011	
	(0.114)	(0.063)	(0.070)	
founder is CEO	0.146		0.037	
	(0.103)		(0.087)	
founder's family on board	-0.013		0.130*	
	(0.101)		(0.070)	
family equity ownership	0.124	0.065	-0.118	
	(0.102)	(0.063)	(0.079)	
bank executive on board	0.475***	0.476***	0.039	
	(0.149)	(0.139)	(0.059)	
media executive on board	0.237***	0.212***	0.095***	
	(0.041)	(0.025)	(0.022)	
politician on board	-0.398***	-0.397***	-0.043	
	(0.124)	(0.127)	(0.075)	
politician family on board	0.209**	0.199**	0.045	
	(0.082)	(0.079)	(0.042)	
bank executive senior manager	-0.392**	-0.367***	-0.016	
	(0.173)	(0.132)	(0.063)	
Observations	1012	1012	1194	1194
R^2	0.312	0.306	0.488	0.463
Quarter FE	Yes	Yes	Yes	Yes

Table 4: Actual rate and breakeven rate

This table reports the baseline estimates of equation (20), where columns (1)-(5) incrementally add covariates. Column (6) reports the results from augmenting equation (20) 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***	0.293***	0.282***	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	-0.050	-0.151**	
			(0.088)	(0.090)	(0.062)	
Assets			0.082	0.048	0.224**	
			(0.132)	(0.132)	(0.096)	
Liabilities/Assets			0.004	0.003	0.001	
			(0.006)	(0.006)	(0.006)	
Maturity				-0.072	-0.007	-0.004
				(0.065)	(0.044)	(0.042)
Collateral				0.262	0.034	-0.249
				(0.193)	(0.163)	(0.271)
Observations	1625	1625	1571	1529	1486	1549
R^2	0.339	0.389	0.390	0.395	0.442	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 5: Lagged interest rates

This table augments equation (20) 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***	0.198***	0.079
	(0.042)	(0.042)	(0.042)	(0.045)	(0.039)	(0.108)
Actual Rate$_{t-1}$	0.567***	0.556***	0.580***	0.583***	0.537***	0.523***
	(0.093)	(0.091)	(0.072)	(0.074)	(0.060)	(0.105)
OROA			-0.012	-0.011	-0.014	
			(0.015)	(0.016)	(0.013)	
Deposits			0.053	0.070	-0.021	
			(0.078)	(0.077)	(0.066)	
Assets			0.063	0.049	0.232**	
			(0.098)	(0.096)	(0.094)	
Liabilities/Assets			0.002	0.002	0.001	
			(0.005)	(0.005)	(0.005)	
Maturity				-0.011	-0.013	-0.009
				(0.059)	(0.057)	(0.075)
Collateral				0.169	-0.013	-0.247
				(0.158)	(0.162)	(0.287)
Observations	1423	1423	1389	1364	1331	1376
R^2	0.447	0.488	0.490	0.498	0.527	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 6: Asymmetric pass-through

The dependent variable is the actual rate of each loan in all columns. Columns (1)-(2) only include borrowers whose first reported breakeven rate in 2015 is below the median breakeven rate of initial breakeven rates. Columns (3)-(4) only include the borrowers whose first reported 2015 breakeven rate is above the median of initial breakeven rates. 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**	0.432**	0.041	0.044
	(0.190)	(0.180)	(0.093)	(0.092)
Maturity		0.082**		-0.083
		(0.039)		(0.079)
Collateral		-0.260		0.043
		(0.232)		(0.231)
Observations	544	532	883	863
R^2	0.480	0.496	0.411	0.432
Quarter FE	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No
Firm FE	Yes	Yes	Yes	Yes

Table 7: Future borrower credit rating

This table reports the results from estimating equation (21). The dependent variable in all columns is a borrower's rating 12 months later. Diff_{it} for a borrower i in month t is calculated as the average across all of the borrower's loans' actual - breakeven rate in t. Column (1) shows the result for all observations. Column (2) only includes observations with negative Diff_{it}, and column (3) only includes observations with positive Diff_{it}. A lower value of the variable "Rating" corresponds to better credit quality. Standard errors are clustered by borrower, and reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	(1) All Customers	(2) Negative Dif	(3) Positive Dif
Dif	-0.084	-0.070	0.006
	(0.068)	(0.134)	(0.135)
Rating	0.704***	0.705***	0.690***
	(0.092)	(0.201)	(0.094)
Observations	465	123	342
R^2	0.519	0.631	0.396
Quarter FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Firm FE	No	No	No

Table 8: Regulatory costs and actual rate

This table reports the results from augmenting the baseline equation (20) 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 a loan's interest rate 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	0.248***	0.277***	0.244**	0.268***
	(0.083)	(0.080)	(0.098)	(0.092)
Regulatory Capital Cost	0.124	0.042	0.112	-0.007
	(0.732)	(0.643)	(0.910)	(0.887)
OROA	-0.027	-0.026	-0.033*	-0.018
	(0.018)	(0.016)	(0.017)	(0.027)
Deposits	-0.157**	-0.151**	-0.181**	-0.100
	(0.064)	(0.061)	(0.079)	(0.144)
Assets	0.229**	0.225**	0.268**	0.217
	(0.104)	(0.098)	(0.126)	(0.172)
Liabilities/Assets	0.003	0.001	0.001	0.005
	(0.006)	(0.006)	(0.007)	(0.008)
Maturity	0.023	-0.007	0.043	0.047
	(0.040)	(0.044)	(0.040)	(0.065)
Collateral	0.075	0.037	-0.070	-0.108
	(0.174)	(0.158)	(0.223)	(0.335)
Observations	1486	1486	1054	296
R^2	0.397	0.442	0.389	0.438
Quarter FE	No	Yes	No	No
Industry FE	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No

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

$$R^{L,c} = (r + \rho) \frac{D}{C} - \rho C^*. \tag{23}$$

However, (7) implies

$$\pi^L < r^* - p^H (1 - C^*). \tag{24}$$

But condition (11) together with (23) and (24) imply

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

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

$$\frac{R^{L,c} - R^{H,c}}{\rho (1 - C^*)} = \frac{\pi^L - R^{H,c}}{\rho (1 - C^*)} = \frac{\pi^L - \left(r + (r + \rho) \left(\frac{D}{C} - 1 \right) + p^L \left(\frac{D}{C} - V^{L,c} \right) \right)}{\rho (1 - C^*)}. \tag{25}$$

Conditions (11) and (24) imply

$$\pi^L < r\frac{D}{C} + \rho \left(\frac{D}{C} - C^* \right). \tag{26}$$

Combining (25) with (26) leads to

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

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

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.

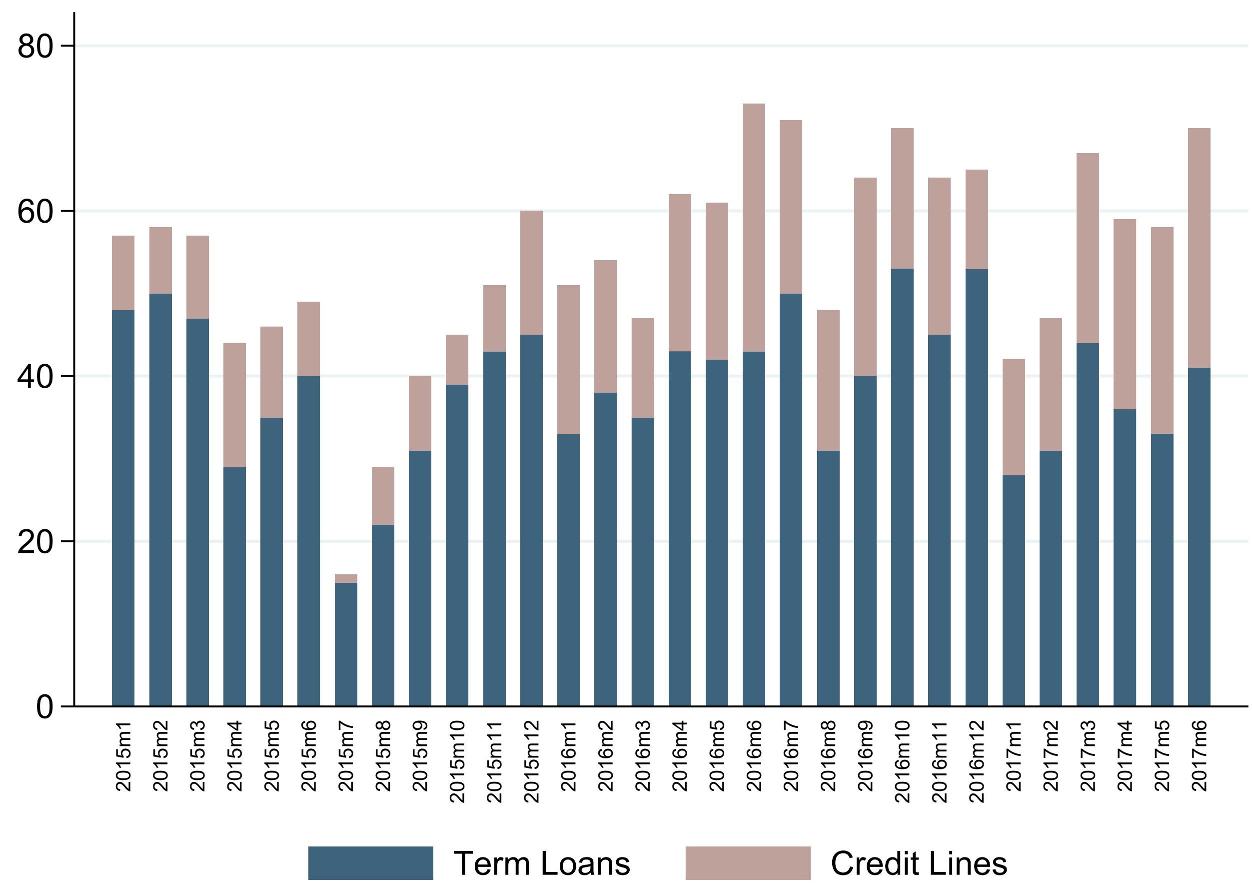
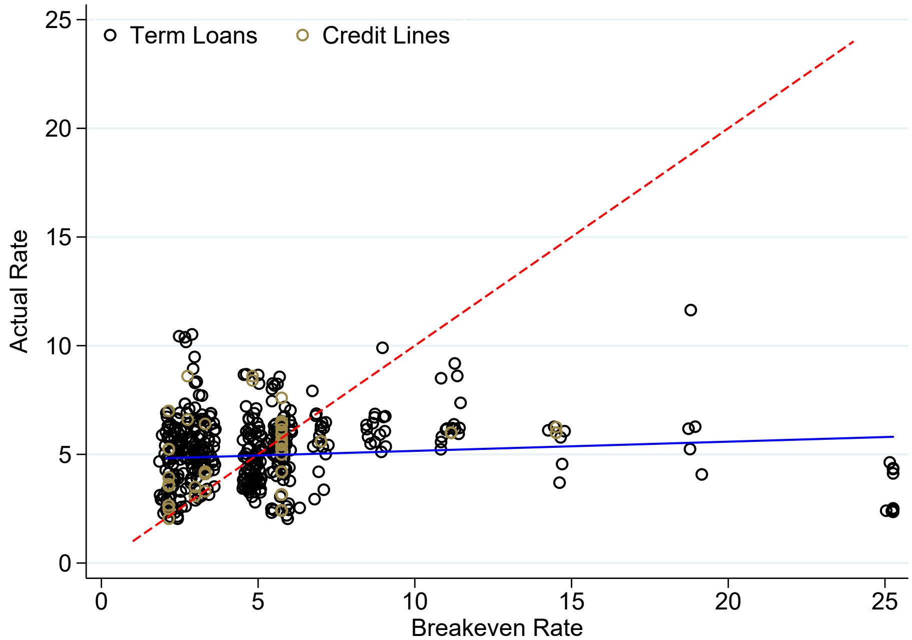


Figure A2: Actual rates and breakeven rates in 2014 and 2015

This figure shows the scatter plot of actual and breakeven 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

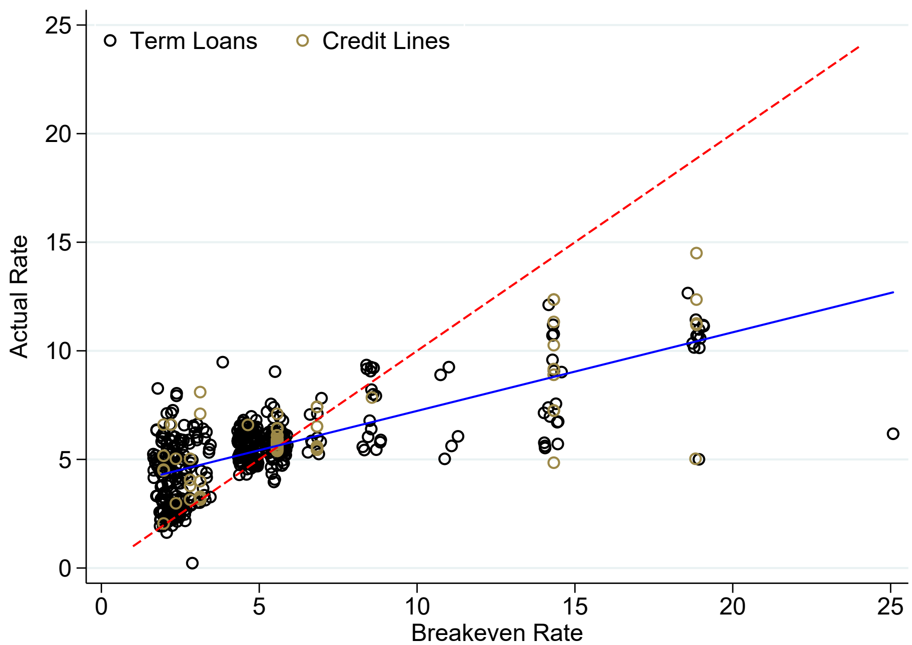


Figure A3: Borrower composition

This figure shows borrower composition over the sample period. The figure includes 89 borrowers who receive a loan in 2015 and furthermore appear in the sample in at least two separate quarters. For each borrower, filled boxes represent the quarters in which they open a new loan with the bank. Each borrower is color coded such that dark red corresponds to borrowers who receive an upward breakeven-rate adjustment, light pink corresponds to borrowers who receive a downward breakeven-rate adjustment, and medium red corresponds to those who do not receive any adjustment.

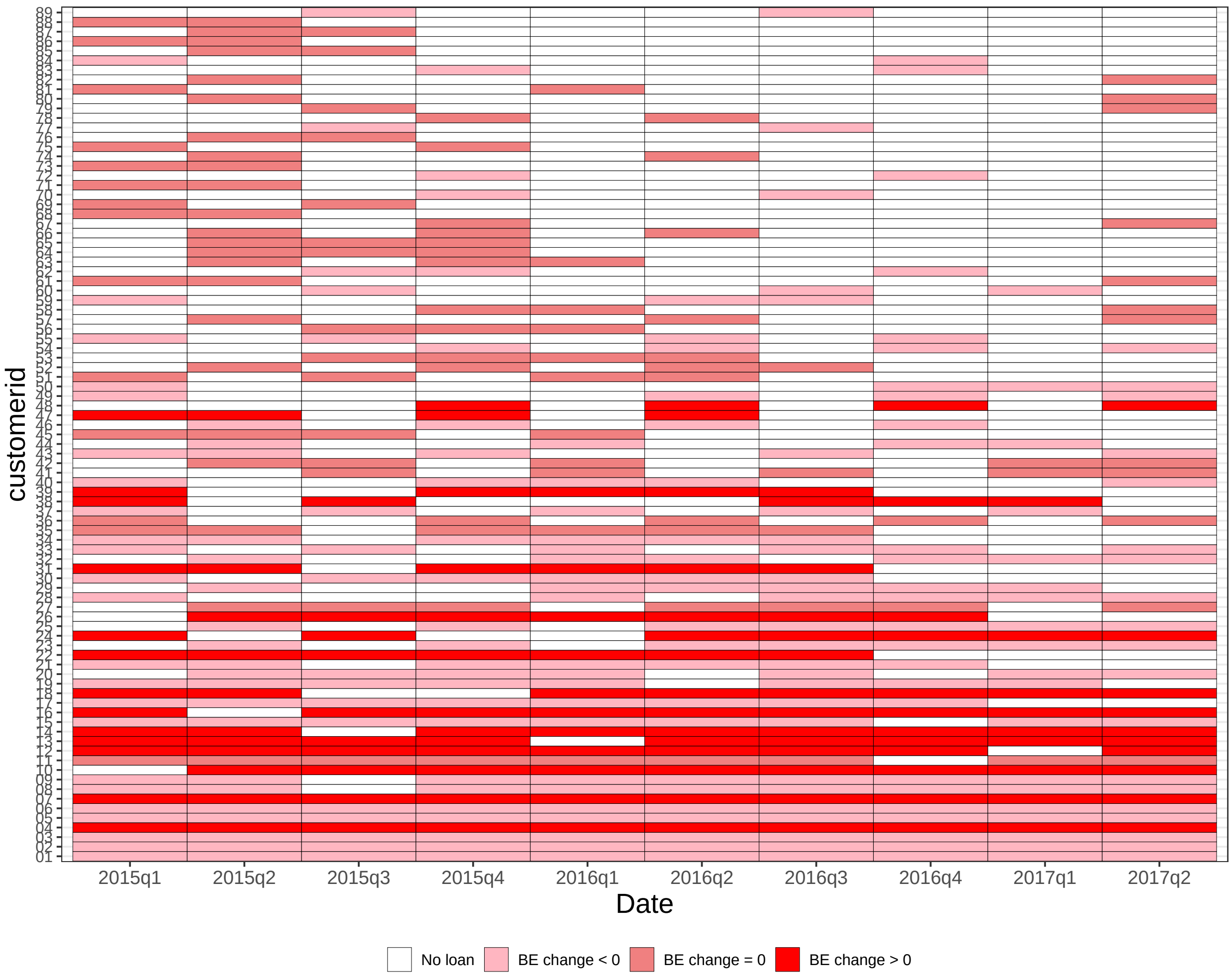


Figure A4: [Continued] Borrower composition

This figure shows borrower composition over the sample period. The figure includes 89 borrowers who receive a loan in 2015 and furthermore appear in the sample in at least two separate quarters. For each borrower, filled boxes represent the quarters in which they open a new loan with the bank. The sample borrowers are divided into three tercile groups according to their initial Diff, namely, the difference between the actual interest rate and breakeven rate. Each borrower is color coded such that dark red corresponds to borrowers in the top tercile, medium red corresponds to the middle tercile, and light pink corresponds to the bottom tercile.

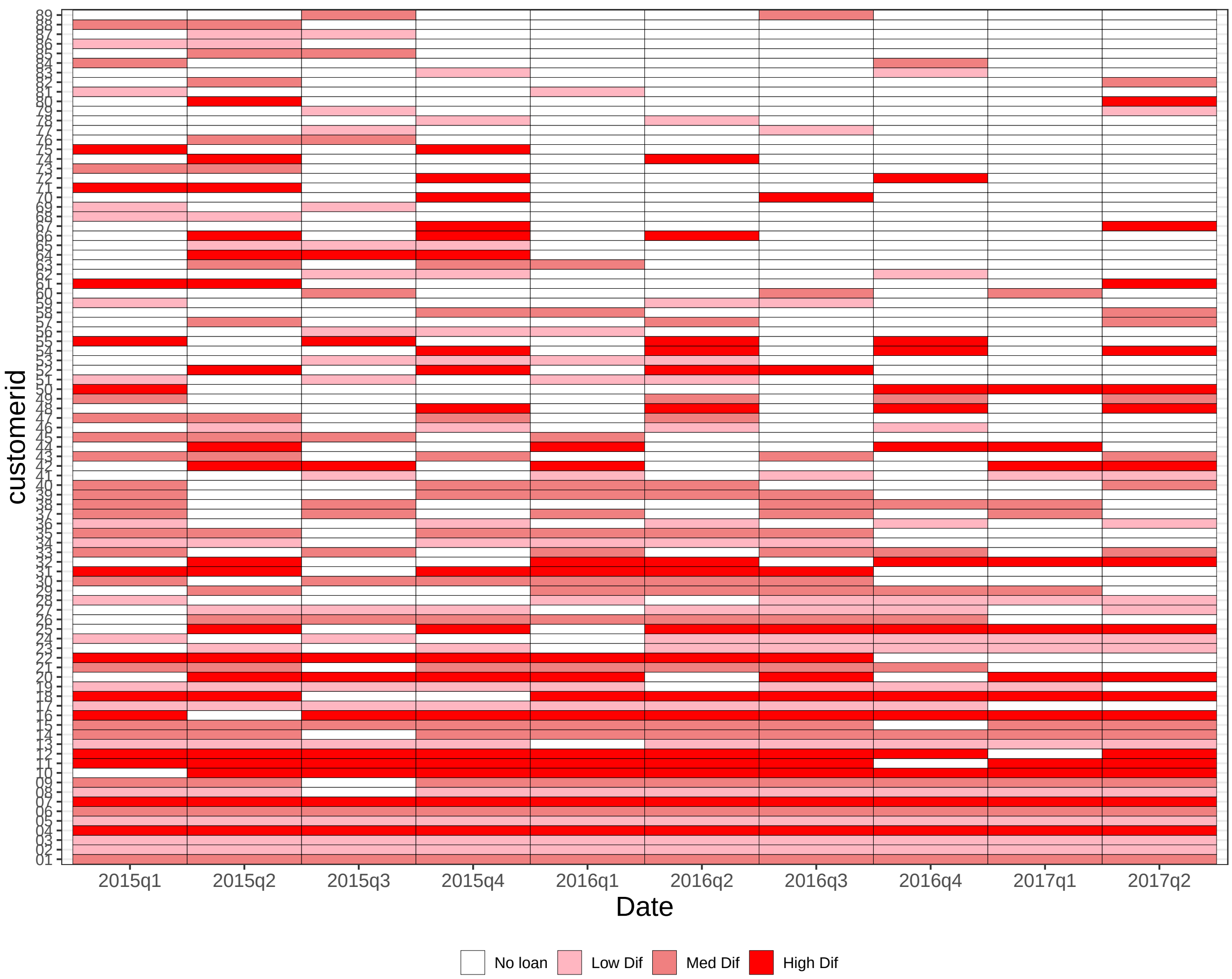


Table A1: Variable definitions

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.
Diff	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
founder is CEO	The founder is the CEO
founder's family on board	The founder's family member 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
politician family on board	Number of board members who have family members with political affiliations
bank executive senior manager	Has a senior manager who was a bank executive

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
Dif (%)	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
Dif (%)	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
Dif (%)	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
Dif (%)	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
Dif (%)	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
Dif (%)	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 4, but for term loans only.

	(1)	(2)	(3)	(4)	(5)	(6)
Breakeven Rate	0.292***	0.309***	0.289***	0.294***	0.283***	0.066
	(0.037)	(0.034)	(0.043)	(0.045)	(0.044)	(0.067)
OROA			-0.023	-0.023	-0.030**	
			(0.018)	(0.018)	(0.015)	
Deposits			-0.014	-0.002	-0.162**	
			(0.096)	(0.103)	(0.078)	
Assets			0.038	0.017	0.234*	
			(0.139)	(0.139)	(0.119)	
Liabilities/Assets			0.004	0.003	-0.001	
			(0.007)	(0.006)	(0.006)	
Maturity				-0.061	0.001	-0.018
				(0.071)	(0.046)	(0.049)
Collateral				0.173	-0.121	-0.421
				(0.226)	(0.193)	(0.355)
Observations	1163	1163	1114	1095	1054	1112
R^2	0.320	0.400	0.402	0.404	0.455	0.631
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 4, but for credit line accounts only.

	(1)	(2)	(3)	(4)	(5)	(6)
Breakeven Rate	0.298***	0.304***	0.230***	0.237**	0.208*	0.187
	(0.064)	(0.067)	(0.049)	(0.088)	(0.110)	(0.194)
OROA			0.047	0.068	0.066	
			(0.047)	(0.087)	(0.097)	
Deposits			-0.492***	-0.499*	-0.513	
			(0.149)	(0.276)	(0.330)	
Assets			0.439***	0.467	0.414	
			(0.156)	(0.277)	(0.307)	
Liabilities/Assets			0.009	0.020	0.026	
			(0.010)	(0.016)	(0.020)	
Maturity				-0.094	-0.044	2.495
				(1.001)	(1.059)	(1.973)
Collateral				1.001**	0.627**	0.129
				(0.341)	(0.282)	(0.303)
Observations	462	462	457	434	432	437
R^2	0.338	0.381	0.440	0.482	0.489	0.569
Quarter FE	No	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	Yes	No
Firm FE	No	No	No	No	No	Yes