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Do your Rivals Enhance your Access to Credit? Theory and Evidence

Vittoria Cerasi, Alessandro Fedele, Raffaele Miniaci

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Vittoria Cerasi[a] **Alessandro Fedele**[b] **Raffaele Miniaci**[c]

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Abstract

In this paper, we unveil a disregarded benefit of product market competition for small and medium enterprises (SMEs). In a model where firms are financed through collateralized bank loans and compete à la Cournot, we introduce a probability of bankruptcy. We investigate how the number of rivals and the existence of outsiders willing to acquire productive assets of distressed incumbents affect the equilibrium share of investment financed with bank credit. Using a sample of Italian SMEs, we find evidence that product market competition impacts positively on the share of investment financed with bank credit only when outsiders are absent.

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Keywords: product market competition; collateralized bank loans; productive assets.

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[a]Corresponding author: Bicocca University, Department of Economics, Management and Statistics, Piazza dell'Ateneo Nuovo 1, 20126 Milano, Italy; e-mail: vittoria.cerasi@unimib.it; phone: +39-02-6448-5821.

[b]Free University of Bozen/Bolzano, Faculty of Economics and Management, Piazza Università 1, 39100 Bolzano, Italy; e-mail: alessandro.fedele@unibz.it.

[c]University of Brescia, Department of Economics and Management, Via S.Faustino 74/b, 25122 Brescia, Italy; e-mail: raffaele.miniaci@unibs.it.

1 Introduction

External finance is a vital ingredient for firms willing to undertake productive investments. However, the availability of external finance varies across countries and industries and especially dampens the growth of small and medium enterprises (SMEs, henceforth) according to the evidence in, e.g., Rajan and Zingales (1998). Policymakers seeking solutions to promote external finance to SMEs have so far disregarded the effect of product market competition (PMC, henceforth), although several papers have recently focused on the relation between PMC and corporate finance (Valta, 2012, Frésard and Valta, 2014, Huang and Lee, 2013, and Xu, 2012, to cite some).

The access to external finance to undertake new investments depends on the income that can be pledged to creditors, as illustrated extensively by Holmstrom and Tirole (1997). Greater competition in the product market, through shrinking profits, reduces the amount of revenues that can be pledged to creditors and, in turn, may worsen credit conditions.

However, firms may be able to boost credit by collateralizing productive assets (PAs, henceforth). In the case of collateralized loans, before extending credit, lenders consider not only firms' expected profitability but also the resale value of collateralized PAs, which in case of distress can be seized and liquidated. Evidence presented by Almeida et al. (2009), Ortiz-Molina and Phillips (2010) and Benmelech and Bergman (2009) prove that credit conditions are affected by the resale value of PAs. One of the most important determinants of the value at which PAs can be resold is the existence of firms willing to acquire the assets from the distressed firm and reuse them in production. Intuitively, the resale value of PAs is at its highest when the buyer does not incur costs when redeploying the PAs. This is more likely for firms within the same industry, i.e., "rivals" competing in the same market. As a final remark, not only the competitors' mere existence but also their financial strength is crucial. Shleifer and Vishny (1992) were the first to point to the state of health of rivals in the same industry as an important determinant of the resale value of productive equipment. Empirical support can be found in the work of Acharya et al. (2007), who measure how industry characteristics affect recovery rates of PAs.

In this paper, we acknowledge that PMC influences both firms' expected profitability and the resale value of collateralized PAs and then investigate the effect of this twofold mechanism on credit conditions for firms. This appears to be a novel approach.

More precisely, we first develop a theoretical framework, where the product market structure is characterized by both the number of incumbents and the existence of potential entrants. We then design an empirical test to gauge the predictions of the model on a sample of Italian SMEs. In the theoretical model, firms competing à la Cournot in their product market apply for bank loans to undertake productive projects. Given our focus on SMEs, that typically have limited direct access to financial markets, bank credit is assumed to be the only source of external funding. In order to boost bank credit, firms post their PAs as collateral. The productive projects are risky, i.e., they fail with a positive and independent probability, in which case banks will not be repaid. Informed banks, anticipating this outcome, can seize the collateralized PAs of distressed firms and liquidate the assets before production takes place. The PAs are traded in an auction where rivals in the same product market are the potential buyers. We derive the equilibrium quantity of this game and show that it departs from the Cournot equilibrium due to the non-zero probability of default, while encompassing the standard result when such a probability is zero.

Our main finding is as follows. There is a non monotonic relationship between the equilibrium share of individual firms' investment financed with bank credit and the number of rivals in a market, driven by the equilibrium quantity. The intuition rests on the following trade-off. On the one hand, the number of rivals positively affects the expected resale value of PAs, thus enhancing the income that can be pledged to banks. This is because the PAs of a failing firm are valuable only if there are healthy rivals willing to bid for them. The probability of such a favorable event obviously increases along with the number of competitors. On the other hand, the number of rivals negatively affects the equilibrium price and the firms' profits, thereby shrinking both the equilibrium quantity and the equilibrium credit to firms.

An important extension of the model considers firms producing the same or similar goods outside the market and willing to participate in the auction for PAs in liquidation. These "outsiders" aim to acquire productive capacity and enter the market; their existence enhances the resale value of PAs, hence, at equilibrium, both the production quantity and the share of credit to firms are larger than in the case without outsiders. Nonetheless, the beneficial effect of a larger number of incumbent rivals on the expected resale value of PAs vanishes.

Overall, our model predicts that greater PMC, measured by an increase in the number of (incumbent) rivals, does not benefit the equilibrium share of investment financed with bank credit when SMEs operate in markets with outsiders, i.e., potential entrants willing to participate in the auction for PAs. By contrast, the impact on the equilibrium share can be positive when these outsiders are absent.

The paper proceeds with an empirical test of our predictions, based on the 10th survey on Italian Manufacturing Enterprises run by UniCredit Bank Group. This Survey contains self-reported data for the years 2004-2006 on a representative sample of Italian manufacturing companies. Each company releases information about the nature of its investment and how it has been financed. In particular, we focus on purchases of machinery and productive equipment. In addition, we collect information about the competitive conditions in the local product market of each company and about the location of all main rivals - either within or outside the same local market.

These data provide us with the information on both borrowing and non-borrowing firms, and enable us to connect the borrowing behavior of a company to a specific investment need. In this way, we are able to investigate how PMC affects the investment decision, the decision to finance the investment with bank debt, and the percentage of the investment financed by the bank. However, we have no information on the collateral connected to the loan. Our focus on purchases of machinery and productive equipment, where the collateral is most likely PAs, aims to overcome the problem of limited information.

When applying our empirical model to this cross-section sample of firms we are able to gauge the determinants of the decision to invest together with the choice of financing that specific investment. In addition, we derive the set of variables affecting the percentage of the investment financed with bank debt.

We show that more PMC, measured by a lower Herfindahl Index in the local product market, has no economically relevant effect on the percentage of the investment financed with bank debt. Driven by the results in the theoretical model, we divided our sample into two sub-sets, according to the presence or absence of outsiders that might bid for the acquisition of PAs. The empirical evidence provides support for the result of our theoretical model. We find a positive effect on the equilibrium share of bank credit used to fund investment only for companies whose rivals are all active in the same local market. A drop in the Herfindahl Index from the third to the first quartile is associated with +0.94 in the percentage of the investment financed with bank debt. However, this effect fades away when there are rivals competing outside the local market. This result is robust to different measures of PMC and to the inclusion of subsidized loans within a policy to promote credit for SMEs.

The novelty of our empirical analysis lies in the analysis of the interaction between PMC and second-hand market for PAs to determine firms' investment and financial choices. Evidence in Rauh and Sufi (2012) indirectly points to the relevance of this collateral channel when suggesting that cross-section differences in leverage are explained by what firms produces and by the type assets used in production.

The result of our analysis have important implications in terms of the access to credit for SMEs. When bank credit shrinks, for example as the result of a credit crunch, it might be important to explore any possible way to improve long-term access to bank finance for SMEs (see, for instance, Berger and Udell, 1995, and more recently Giovannini et al., 2015, for ways to reduce SMEs' opaqueness or to improve long-term relationships). We suggest that policies aiming to promote competition in the product market could have the additional, yet disregarded, benefit of enhancing credit conditions for SMEs only when the best potential users of the PAs are limited to rivals within the same market. Thus, an important intake from our model is that the effect of PMC on external finance to SMEs crucially depends upon the structure of the second-hand market of PAs.

Related literature. Our paper contributes to the recent empirical literature that investigates the effect of PMC on credit conditions for firms. Valta (2012) and Huang and Lee (2013) focus on the cost of credit. In particular, Valta (2012) analyzes the terms of loan contracts for a panel of US firms and finds evidence of an increase in the cost of debt for firms operating in more competitive industries. Similarly, Huang and Lee (2013) find a positive effect of PMC on the probability of default, that in turn increases credit costs. Xu (2012) and Frésard and Valta (2014) gauge the effect of an increase in PMC following trade liberalization on individual firms' behavior. While Xu (2012) finds a negative effect on leverage through profitability, Frésard and Valta (2014) show a negative effect on investment due to the threat of entry related to trade liberalization. Our empirical evidence contrasts in some respects with Valta (2012), Huang and Lee (2013) and Xu (2012) since we find a positive impact of PMC on the equilibrium percentage of bank credit to SMEs that operate in industries where rivals are all inside the same local market. Furthermore, our empirical exercise discloses a positive effect of potential entry on firms' choice to invest. This is in contrast with, e.g., Frésard and Valta (2014). It should be noted, however, that their focus is on large firms, while ours is on SMEs; in addition, we select those investments that are likely to use productive assets as collateral, while they adopt a broader definition of collateral including real estate.

There is a relevant empirical literature stating that investment and credit are connected by the collateral channel. As mentioned, the initial intuition is in Shleifer and Vishny (1992), who suggest that PAs are mostly valuable for competitors in the same industry and that credit-constrained firms can increase their debt capacity when the recovery rate of their PAs is at its maximum, i.e., when direct rivals are in a position to bid for the assets.[1] Our paper adds to that literature a more precise identification of the channel by which product market structure affects both the level of profitability and the recovery value of PAs.

To the best of our knowledge there are no papers pointing to both PMC and the second-hand market for PAs as crucial determinants of SMEs' investment and financial choices. For instance, the effect of shocks in the real estate and land prices on firms' investment is investigated by Gan (2007) in Japan and Chaney et al. (2012) in the US, while Almeida et al. (2009) focus on the relation between investments and the degree of liquidity of firms' PAs. Even though the relation between marketability of PAs and firms' investment behavior in these papers is similar to that considered in our model, the link between product and collateral markets is missing. Indeed, when considering real estate or land as collateral, the degree of asset specificity is low and any active firm may be willing to bid for the PAs, regardless of the specific industry to which the firm belongs.

Although not focused directly on PMC, the analysis in Almeida et al. (2009) introduces a proxy for asset tangibility across industries based on the idea that the best re-users of the PAs are the firms belonging to the same industry. This idea is central in Benmelech and Bergman (2011) who study the spread of secured debt tranches issued by U.S. airlines. They show that the deterioration of a company's financial conditions has a sizeable impact on the cost of debt of other industry participants as a result of the loss of value of their collateral. In terms of amount of debt, the (positive) relation between collateral liquidation value and loan-to-value ratio is studied by Benmelech and Bergman (2009) for the U.S. airline industry. Norden and van Kempen (2013) find that firms with a higher fraction of redeployable assets have higher total leverage, while Gan (2007) shows that the loss of value in the collateral reduces the ability of firms to obtain bank lending. Benmelech et al. (2005) show that firms within the same residential area raise more debt when there are more potential buyers of their collateralized assets. Again, this evidence is consistent with the idea that the degree of liquidity of PAs has a positive effect on bank lending. Yet, the resale value of PAs is not associated with the product market structure in Benmelech et al. (2005). Finally, some interesting insights come from the empirical analyses in MacKay and Phillips (2005) and, especially, from the aforementioned paper by Rauh and Sufi (2012), where the product market structure along with the type of productive assets are important determinants of leverage for a panel of US firms.

A strand of theoretical literature relates credit availability to PMC (see, e.g., Brander and Lewis, 1986, and the survey by Cestone, 1999). However, the main focus is on the impact of external finance on competitive behavior of firms in the product market. The novelty of our paper is to explore the reverse causality, i.e., the impact of PMC on external finance. To the best of our knowledge we are not aware of other theoretical papers where this feedback is explored, except Cerasi and Fedele (2011), where investment and financial choices are studied in a duopoly setting with asymmetric information between firms and lenders. Here we assume symmetric information but extend that analysis to the case of a larger number of firms competing in the product market, with and without the presence of outsiders competing for the ownership of PAs. Finally, Almeida et al. (2009) develop a theoretical model with independent liquidity shocks similar to the one in

[1] Empirical support to this prediction is provided by Acharya et al. (2007), Habib and Johnsen (1999), Ortiz-Molina and Phillips (2010) and Gavazza (2010).

this paper in order to study the availability of credit lines for firms with industry-specific PAs; however, they ignore PMC.

Our empirical exercise departs from the existing literature in several ways too. First, we consider investment and financing decisions jointly and we allow product and PAs market conditions to affect the two decisions in different ways. By doing so, we can investigate the effects of changes in market conditions on the behavior of the entire population of companies and not only on the financing decisions of the endogenously selected group of firms resorting to collateralized credit. Second, we focus on tangible investment with a high degree of specificity, but we do not limit the analysis to one single industry as in Benmelech and Bergman (2009, 2011). We can therefore exploit the interplay between output and the market structure of PAs to assess the role played by PMC on credit access. Third, we focus on small and medium enterprises (SME), companies with limited direct access to financial markets and for which bank lending is essential. Our empirical approach is in sharp contrast to most of the existing literature, where either debt contracts or relatively large companies (with direct access to the financial markets) are the units of observation.

The exact matching between debt contract and the underlying collateral might be provided by a dataset of matched bank-firm lending, reporting detailed information on each individual debt contract (e.g., Gan, 2007, and Valta, 2012), or in data reporting information on secured debt tranches as in Benmelech and Bergman (2011). Yet, credit register data in Italy do not report information on the collateral related to each single line of credit and, more importantly, on the specific investment that has been financed. A dataset of matched bank-firm lending would have the advantage of gathering more information on the collateral, but it would come with the major drawback of restricting the analysis to the endogenously self-selected group of borrowers.

The remainder of the paper is organized as follows. Section 2 describes the setup of the model, while Section 3 derives the equilibrium when participation in the auction for PAs is restricted to insiders. Section 4 studies the equilibrium properties by performing some comparative static exercises. Section 5 relaxes one of the assumptions of the model and extends it to the case in which also outsiders participate in the auction for PAs. In Section 6 we summarize the predictions of the theoretical model. Section 7 contains the empirical test, the description of our sample and the results of the econometric analysis. Section 8 concludes the paper. Finally, proofs and robustness checks for the theoretical model are contained in the Appendix.

2 The Economy

We develop a simple model to investigate the relationship between the product market structure of bank-financed firms and the level of collateralized credit. Consider an industry with $N \in [2, \infty)$ symmetric risk-neutral firms, each one denoted by $i = \{1, ..., N\}$. At date 0 firm i invests the amount $I_i = cq_i$, where q_i denotes the production capacity and c the cost of installing each unit of capacity. In this context, we introduce a negative shock. At date 0 the probability that firm i will be active in the product market at the future date 1 is $p \in (0, 1]$, in which case the firm will produce a homogeneous good and will make a profit. By contrast, with probability $(1 - p)$ firm i will be hit by a negative shock, in which case it will not be active in the product market at date 1 and its profits will be zero. Probabilities p are i.i.d. across firms.

Firm i owns limited funds $M \in (0, cq_i)$. The residual amount $(cq_i - M)$ is borrowed from a risk-neutral bank at date 0. Bank i is referred to as the bank lending to firm i. The loan agreement consists of a collateralized debt contract. As will become clear, firm i is not to be able to repay the debt when hit by the negative shock, in which case it defaults.

Banks are informed creditors. As such, at an interim date 1/2 they receive a perfect signal about the future realization of profits.[2] If the signal is negative - this occurs with probability $(1 - p)$ - bank i anticipates that firm i will not be able to repay the debt at date 1; it then seizes the PAs of the defaulted borrower, i.e., assets bought at date 0 to install capacity q_i, sells them in the second-hand market, and cashes their liquidation value. The PAs are sold at an auction, where the only potential bidders are healthy rivals, i.e., those not hit by the shock.[3]

Because healthy firms are credit constrained, they must be granted additional funds from their banks in order to participate in the auction. We denote with $r_i > 0$ the face value firm i, when healthy, commits to repay to bank i at date 1. For simplicity, we assume that r_i is such that bank i breaks even when granting the loan $(cq_i - M)$ at $t = 0$ and the extra funds at $t = 1/2$ in case firm i is healthy.

Before proceeding, we specify the timing of events in our model.

- At date 0 each firm i invests own funds M and borrows $(cq_i - M)$ from bank i to set the capacity q_i for its plant; all firms set their capacity non cooperatively and simultaneously.

- At the interim date 1/2 each bank i receives a perfect signal about firm i's future realization of profits. In case of a negative signal, bank i seizes firm i's PAs, which are then auctioned off.

- At date 1 healthy firms compete in the product market by producing at the maximum capacity level, the production cost being zero.[4] This maximum level is given by the capacity installed at date 0 plus the capacity derived from failing rivals' PAs that are acquired at the auction. The inverse demand function for the homogeneous good supplied by healthy firms is given by $P = S - bQ$, where S denotes the consumers' maximum willingness to pay and b measures how the price P is affected by changes in total industry output Q. We let the unit capacity cost c belong to the interval $[0, S)$.

3 Equilibrium

We compute the equilibrium of the three-date model described in Section 2 by restricting our attention to pure-strategy subgame perfect Nash equilibria (SPNEs). Note that competition at the final date 1 has a trivial solution because healthy firms are assumed to produce at the maximum capacity, whose equilibrium

[2] In the literature there are justifications for this assumption. Rajan (1992), e.g., assumes that banks are informed creditors compared to other "arm's-length" creditors such as bondholders. In his paper bondholders do not have any incentive to collect information once they have extended the loan, while banks intervene to liquidate projects since they obtain private information about the realizations of future cash flow.

[3] The default state is due to a firm's specific shock. As a consequence, when the ownership of the PAs is transferred, the value of these assets can be restored by the acquiring firm. This could be interpreted as a shock related to human rather than to physical capital, in line with Cerasi and Fedele (2011). Alternatively one could think of a shock due to a poor quality product in an expanding market. For instance, small firms producing "wrong quality" products may be driven out of the market by competitors.

[4] In Appendix B.1, we relax this hypothesis by allowing each healthy firm to set optimally the Cournot quantity at date 1.

level is given by the solution to date 0 and date 1/2 subgames. Accordingly, we first study the auction for failing firms' PAs at date 1/2. We then go back to compute the equilibrium capacity level, chosen by firms at date 0.

At date 1/2, healthy firms decide simultaneously how many failing rivals' PAs to buy and the amount of their bids. We claim that all healthy firms are willing to bid for all of the PAs on sale.[5] In case of a tie in the bids, indivisible PAs are randomly allocated to a single bidder, the winning bidder; only the winner pays the bid. In mathematical terms, this is the same as assuming that the ownership of the PAs is instead divisible and uniformly shared among and paid by the tying bidders.

On these grounds, we compute the equilibrium bids for the failing firms' PAs. Three alternative scenarios must be investigated separately depending on the number of healthy firms at date 1/2, which we denote by H.

(i) Obviously, when either all firms or none of them are healthy ($H = N$ or $H = 0$) there is no transfer of PAs and no auction.

(ii) When $H \in [2, N-1]$ firms are healthy at date 1/2, we rely on a Bertrand argument to state that the equilibrium bid for any single failing firm's PAs coincides with the maximum amount of money healthy firms are willing to commit to a bid. This amount is defined as reservation value and given by the extra-revenue any healthy firm obtains after the acquisition of a failing rival's PAs. In symbols,

$$P_N 2q^* - P_N q^* = P_N q^*, \tag{1}$$

where q^* denotes the symmetric capacity level set at date 0 and $P_N = S - bNq^*$ indicates the price of the homogeneous good when, given that all failing firms' PAs are acquired by healthy rivals, PAs of all N firms remain productive. The LHS of (1) is the difference between the revenue made by any healthy firm when it acquires a failing rival's PAs, and thus produces $q^* + q^* = 2q^*$, and the revenue when no acquisition occurs, the production being therefore q^*. Because (1) is the same for all healthy firms, there will be a tie in the equilibrium bids, with the effect that any healthy firm gets the PAs with probability $\frac{1}{H}$, where $H \in [2, N-1]$ is the number of tying bidders. Note that at date 1/2 the capacity cost cq^* does not enter in (1) because cq^* is a sunk cost.

(iii) Finally, when only one firm is healthy at date 1/2, i.e., $H = 1$, the equilibrium bid for the PAs of each of the $(N-1)$ rivals is equal to ε, where ε is an arbitrarily small positive amount. This infinitesimal amount is sufficient (and optimal) to become the owner of the PAs by winning the auction when only one firm participates.

3.1 Special Case with $N = 3$

To clarify the intuition, we first derive the equilibrium capacity in the special case of three firms at date 0, i.e., $N = 3$. The general case is analyzed in the next subsection.

[5] In Appendix B.2, we derive the parametric conditions under which our claim holds true at equilibrium.

We denote by U_1 the representative firm 1's expected profit function at date 0 and by q_1 the capacity level installed by firm 1 at date 0, anticipating that $q^*(3)$ is the equilibrium capacity set by each rival at date 0:

$$U_1 = p(P_3 q_1 - r_1) + p\left[2p(1-p)\frac{1}{2}P_3 q^*(3) + (1-p)^2 P_3 2q^*(3)\right] + (1-p)0 - M. \quad (2)$$

When firm 1 is healthy - with probability p - at date 1 it produces at the maximum capacity, q_1, without additional production costs and it earns $P_3 q_1$, where $P_3 = S - b[q_1 + 2q^*(3)]$ indicates the price of the homogeneous good when total production is equal to total capacity, $q_1 + 2q^*(3)$, regardless of the allocation of PAs among healthy firms; it also repays r_1 to bank 1. In addition, when one rival, either firm 2 or firm 3, fails - with probability $2p(1-p)$ - firm 1 participates in a two-bidder auction, it acquires the failing rival's PAs with probability $\frac{1}{2}$ and its extra-revenue is $P_3 q^*(3)$. This value is obtained by substituting $N = 3$ and $q^*(3)$ into (1). When both rivals fail - with probability $(1-p)^2$ - firm 1 participates in a single-bidder's auction and acquires the PAs of the two rivals with probability 1, hence the extra-revenue is $P_3 2q^*(3)$. By contrast, if firm 1 fails - with probability $(1-p)$ - it earns nothing. Finally, we set the risk-free rate to be zero, so that M denotes the opportunity cost of firm 1's own funds.

We turn to the expected profit function of bank 1, V_1:

$$V_1 = p\left[r_1 - 2p(1-p)\frac{1}{2}P_3 q^*(3) - (1-p)^2 2\varepsilon\right] + (1-p)\left[p^2 P_3 q_1 + 2p(1-p)\varepsilon\right] - (I_1 - M). \quad (3)$$

When firm 1 is successful - this occurs with probability p - bank i receives r_1. Moreover, when only one rival fails - with probability $2p(1-p)$ - bank i lends an expected extra amount $\frac{1}{2}P_3 q^*(3)$ to firm 1 which bids $P_3 q^*(3)$ to buy the PAs of the failing rival, $\frac{1}{2}$ being the probability that firm 1 wins the two-bidder auction and actually pays the bid. With probability $(1-p)^2$ bank i funds the amount 2ε bid by firm 1 to acquire the PAs of both failing rivals in a single-bidder auction. By contrast, firm 1 fails with probability $1-p$. When both rivals are healthy - with probability p^2 - bank i sells firm 1's PAs at price $P_3 q_1$ in a two-bidder auction; with probability $2p(1-p)$ only one rival, either 2 or 3, is healthy and buys at price ε in a single-bidder auction. Finally, the last term, $I_1 - M$, is the opportunity cost of the amount lent to firm 1, since we assume zero risk-free interest rate. Note that the expected extra credit in the event that firm 1 is the only healthy one, $-p(1-p)^2 2\varepsilon$, cancels with the expected value recovered from the sale of firm 1's PAs in case only one rival is healthy, $2(1-p)^2 p\varepsilon$. In other words, bank 1 incurs zero expected cost when buying PAs of failing firms 2 and 3.

To compute the expected repayment pr_1 owed by firm 1 to bank 1, we substitute $I_1 = cq_1$ into (3) and then solve $V_1 = 0$, which is bank 1's break-even condition, by pr_1. In symbols,

$$pr_1 = (cq_1 - M) + p^2(1-p)P_3 q^*(3) - (1-p)p^2 P_3 q_1. \quad (4)$$

It is worth observing that the expected repayment pr_1 required by bank 1 to break even is positively affected by the opportunity cost of lending, $(cq_1 - M)$, and by the expected extra-credit to firm 1 when the firm participates in a two-bidder auction, $p^2(1-p)P_3 q^*(3)$. On the contrary, pr_1 is negatively affected by the expected value recovered by bank 1 from the sale of firm 1's PAs in a two-bidder auction, $(1-p)p^2 P_3 q_1$.

Plugging (4) into (2) gives firm 1's expected profits at date 0

$$U_1 = p\left[P_3 q_1 + (1-p)^2 P_3 2q^*(3)\right] + (1-p)p^2 P_3 q_1 - cq_1. \quad (5)$$

Expression (5) can be read as follows. With probability p firm 1 is successful and earns $P_3 q_1$. It gains extra revenue $P_3 2q^* (3)$ when it participates in a single-bidder auction - this occurs with probability $p(1-p)^2$ - obtains both rivals' PAs at zero expected cost and produces at the additional capacity $2q^* (3)$. By contrast, with probability $(1-p)$ firm 1 fails and makes no profit; yet, according to (4), the expected repayment pr_1 required by bank 1 to break even is reduced by the resale value of firm 1's PAs, $P_3 q_1$, when both rivals are healthy, which occurs with probability p^2. The last term, cq_1, is the cost of installing capacity q_1.

At date 0 firm 1 chooses q_1 to maximize (5), given that each rival sets the capacity at $q^* (3)$. Taking into account a non-negativity constraint on the capacity level, at the equilibrium of our three-date model the symmetric capacity set by each firm is

$$q^* (3) = \max \left\{ 0, \frac{\left[p + (1-p) p^2\right] S - c}{2bp \left(3 - p^2\right)} \right\}. \tag{6}$$

In conclusion, we remark that substituting $q_1 = q^*$ into (4) yields the equilibrium repayment owed to bank 1, $r_1^* = \frac{cq^*(3) - M}{p}$. Given that $M < cq^* (3)$ by assumption, the repayment is strictly positive, with the effect that firm 1 is actually not able to repay the debt with probability $1-p$, i.e., when its profits are zero due to the negative shock. This result also holds for the equilibrium repayment in the general case with $N \in [2, \infty)$.

3.2 General Case

We study the general case with $N \in [2, \infty)$ firms at date 0 and compute the equilibrium capacity. Similarly to the previous case with $N = 3$, firm i chooses q_i in order to maximize its expected profit function U_i provided that bank i breaks even, i.e., $V_i = 0$. Recalling that q^* denotes the equilibrium capacity installed by all other rivals, in Appendix A.1 we derive the following expression for firm i's expected profits:

$$\begin{gathered} U_i = p \left[P_N q_i + (1-p)^{N-1} P_N (N-1) q^* \right] + \\ (1-p) \left[1 - (1-p)^{N-1} - (N-1) p (1-p)^{N-2} \right] P_N q_i - cq_i, \end{gathered} \tag{7}$$

where q_i is the capacity installed by firm i.

Formula (7) is to be interpreted similarly to (5). With probability p firm i is successful and earns at least $P_N q_i$, with $P_N = S - b \left[q_i + (N-1) q^*\right]$. The extra-revenue $P_N (N-1) q^*$ accrues to firm i when it participates in a single-bidder auction - this occurs with probability $p(1-p)^{N-1}$- acquires all rivals' PAs at zero expected cost, and produces at the additional capacity $(N-1) q^*$. Instead, with probability $(1-p)$ firm i fails and makes zero profit. However, if at least two rivals are healthy - this occurs with probability $\left[1 - (1-p)^{N-1} - (N-1) p (1-p)^{N-2}\right]$ - bank i anticipates it will cash the equilibrium bid $P_N q_i$ paid by the winner of the auction to acquire the PAs of firm i. As a result, the expected repayment pr_i required by bank i to break even is discounted by the amount $P_N q_i$. The last term, cq_i, denotes the cost of installing the capacity q_i.

At date 0 firm i chooses q_i to maximize (7) given that q^* is the capacity set by each rival. At the equilibrium of our three-date model the symmetric capacity set by each firm is computed in the following

Proposition 1 *The symmetric equilibrium capacity when $N \in [2, \infty)$ firms are present at date* 0 *is*

$$q^* = \max \left\{ 0, \frac{S \left\{ 1 - (1-p)^{N-1} \left[1 + p(N-2) \right] \right\} - c}{b \left\{ (N+1) - (1-p)^{N-1} \left[N + 1 + p(N-1)^2 - 2p \right] \right\}} \right\}. \tag{8}$$

Proof. In Appendix A.1. ■

Formula (8) defines the equilibrium capacity in a Cournot oligopoly with N firms, whose PAs are collateralized and where each firm faces an independent default probability. As we will see in the next section, this equilibrium value does not decrease monotonically in N. On the contrary, in the special case of $p = 1$ where no PAs are traded because none of the firms defaults, the equilibrium amount collapses to the standard Cournot equilibrium capacity with linear unit cost c, $\frac{S-c}{b(N+1)}$. This value monotonically decreases in N. We conclude that the possibility of trading PAs crucially affects the capacity chosen by firms at equilibrium.

4 Comparative Statics

We first discuss how the equilibrium capacity q^*, calculated in Proposition 1, varies with the number of firms active at date 0, N, and the success probability, p. Given the complicated formula of q^*, we resort to numerical examples. Without loss of generality, we can fix both parameters S and b to 1.

In Figure 1 we let $c = 0.7$ and draw the equilibrium capacity q^* in space (p, N, q^*), with $p \in (0, 1]$ and $N \in [2, 25]$.

Figure 1 here

Figure 1 shows that:

1. q^* is zero when p tends to zero;
2. q^* is zero for $p \leq 0.7$ when N tends to 2;
3. q^* is positive for any $N \geq 2$ when $p \geq 0.7$.
4. provided that p is not close to 1, there is an inverted U-shaped relation between q^*, when positive, and N.

We now turn our attention to the equilibrium credit. To this end, we transform the equilibrium capacity q^* into a measure of bank credit, i.e., the proportion of credit, $cq - M$, to finance the investment $I = cq$, i.e.,

$$L = 1 - \frac{M}{cq}. \tag{9}$$

Substituting q^* into (9) gives the equilibrium credit L^*. This value is obviously zero when the investment is zero, i.e., when $q^* = 0$ and therefore $cq^* = 0$. According to Figure 1, this occurs in the south-west portion of plane (p, N), where p and N are simultaneously low.

We now focus on $q^* > 0$. To calculate L^* we recall that the equilibrium capacity q^* is computed under the assumption that firms own limited funds $cq^* > M$ and must borrow the amount $cq^* - M$ from banks. In Appendix B.3, we show that the equilibrium capacity remains q^* when firms self-finance the investment, i.e., when $cq^* \leq M$. Accordingly, the equilibrium credit is

$$L^* = \begin{cases} 0 & \text{if } cq^* \in (0, M], \\ 1 - \frac{M}{cq^*} & \text{if } cq^* > M. \end{cases} \tag{10}$$

Note that L^* is zero not only when firms do not invest but also when firms have enough cash to self-finance the whole investment, i.e., when $cq^* \in (0, M]$.

To illustrate the effect of N and p on L^*, in Figure 2 we focus on $p \geq 0.7$, in which case $cq^* > 0$ for any N according to Figure 1, and plot L^* in plane (N, L^*) with $N \in [2, 22]$, $c = 0.7$, and $M = .01$ (S and b are still normalized to 1). From the upper line the probability of success p is set at 0.98 (upper solid line), and then in descending order at 0.9 (upper dashed line), 0.8 (lower solid line) and 0.7 (lower dashed line).

Figure 2 here

Figure 2 shows that there is an inverted U-shaped relation between the equilibrium credit L^* and N, provided that p is not close to 1 (e.g., $p = 0.98$), in which case L^* becomes monotonically decreasing in N. Furthermore, L^* becomes zero when $N \geq 20$ because cq^* falls below M. We can conclude that a constellation of parameters exists such that an increasing number of firms active at date 0 affects credit positively.

We are now able to explain our findings concerning the effect of p and N on q^* and L^*.

1. The equilibrium capacity q^* and the equilibrium credit L^* are zero when p tends to zero because the representative firm i's expected profits (7) become negative when all firms are highly likely to fail.

2. Similarly, q^* and L^* are zero when N tends to 2 and p is relatively small ($p \leq 0.7$ in Figure 1). The intuition is as follows. Suppose $N = 2$, in which case firm i s' expected profits (7) become

$$U_i = p\left[P_2 q_i + (1-p) P_2 q^*\right] + (1-p) 0 - cq_i. \tag{11}$$

   When firm i fails - with probability $(1-p)$ - bank i is not able to recover any positive value from the sale of PAs. Such a negative scenario, where there is no discount of the expected repayment pr_i required by bank i to break even, is likely to occur when p is relatively small. This is why firm i prefers not to invest when N tends to 2 and p is relatively small.

3. For all other values of p and N, q^* is instead positive. As described, q^* and L^* are initially increasing and then decreasing in N, provided that p does not tend to 1. In addition, L^* becomes zero for large values of N. These results can be explained as follows. On the one hand, the equilibrium price $P_N = S - bNq^*$ is negatively affected by N. This is the standard negative effect on the firms' profits and, in turn, on q^* and L^* as the number of competitors rises. On the other hand, a potential positive effect arises as the probability of default is taken into account.

   To illustrate this positive effect, we consider the two lowest values of N, $N = 2$ and $N = 3$. Firm i s' expected profits are given by (11) when $N = 2$ and by (5) when $N = 3$. Comparing these two expressions one can remark that in case firm i is failing a positive liquidation value for PAs, $P_3 2q^*$ (3), may be recovered only when $N = 3$ provided that both rivals are healthy. Put differently, the second-hand PAs of a failing firm are valuable only if at least two rivals are healthy. Because the probability of such a favorable event is positively affected by N, an increasing number of active competitors at date 0 may augment firms' expected profits and in turn q^* and L^*.

However this positive effect tends to vanish when many competitors are active at date 0. From equation (7) we know that when firm i is healthy the probability of earning the extra-revenue $P_N (N-1) q$, $p(1-p)^{N-1}$, tends to zero if $N \to \infty$. By contrast, when firm i is failing the probability that at least two rivals are healthy tends to 1, in which case bank i anticipates it will cash the equilibrium bid $P_N q_i$ paid by the winner of the auction. However, such bid is decreasing in N because P_N is decreasing in N. As a result, any potential positive effect of additional competitors on firms' expected profits disappears when many competitors are active at date 0. This is why the equilibrium quantity q^* is decreasing in N, as $N \to \infty$. In that case, cq^* becomes lower than M and L^* becomes zero.

4. Finally, q^* and L^* are monotonically decreasing in N when p tends to 1. In that case, no trade of second-hand PAs occurs and expected profits (7) become approximately $U_i = P_N q_i - cq_i$. This value is decreasing in N because the equilibrium price $P_N = S - bNq^*$ is negatively affected by N. As a result q^* and L^* are decreasing in N as well. This case coincides with the standard Cournot equilibrium.

5 Entry through Acquisition: the Role of Outsiders

We relax the assumption that only healthy rivals, i.e., those firms active in the market at date 0 and not hit by the negative shock at date 1/2, can participate in the auction of PAs. We consider symmetric risk-neutral firms which produce the same (or a similar) good as the healthy incumbents but are active in a different market. We suppose that at date 1/2 at least two of these firms, referred to as outsiders, are willing to acquire the second-hand PAs in order to enter the market.

We study how the presence of outsiders affects the auction for PAs by computing the equilibrium bids for each failing firm's PAs. Following the previous analysis, we assume that outsiders bid for all of the PAs on sale. In addition, outsider firms have to bear a fixed entry cost, E, to acquire the PAs of each failing incumbent firm.[6] For ease of exposition, we suppose that outsiders have enough cash to finance both their participation in the auction and the entry cost.[7] We analyze three alternative scenarios, depending on the number H of healthy incumbents at date 1/2.

(i) When $H \in [2, N-1]$ incumbents are healthy, their bid for a single failing firm's PAs is $P_N \hat{q}$. This value is taken from (1), with $P_N = S - bN\hat{q}$ and $\hat{q}$ denoting the symmetric equilibrium capacity set by the incumbent firms at date 0 when the potential entry of outsiders is taken into account. The outsiders'

[6] We assume that new firms may enter at $t = 1$ only if they acquire at $t = 1/2$ PAs from distressed incumbents in order to be able to produce in the local market.

[7] One can easily check that the results of this section are not affected when, consistently with our analysis, outsiders are assumed to be endowed with limited funding M and to borrow the residual amount from a risk-neutral bank subject to break-even constraint.

reservation value is instead smaller because of the entry cost E,

$$P_N \hat{q} - E. \tag{12}$$

As a result, the outsiders cannot outbid the incumbents' offer. The equilibrium bid is $P_N \hat{q}$.

(ii) When only one incumbent is healthy, $H = 1$, we rely on the Bertrand argument to assume that it outbids by ε the outsiders' reservation value (12). The equilibrium bid for each failing firm's PAs is $P_N \hat{q} - E + \varepsilon$.

(iii) Finally, when all incumbents fail, i.e., $H = 0$, only the outsiders participate in the auction and their equilibrium bid for each failing incumbent's PAs is given by (12).

It is worth remarking that a crucial difference arises compared to the case without outsiders. Banks recover a positive liquidation value for their distressed clients' PAs under any possible scenario. As a result, firm i's expected profit function (7) becomes

$$U_{i,O} = P_N q_i - (1-p)^N E - c q_i : \tag{13}$$

see Appendix A.2 for computations. Revenue $P_N q_i$, with $P_N = S - b\left[q_i + (N-1)\hat{q}\right]$, is obtained with certainty by firm i, either directly when firm i is healthy, or indirectly through the reduction of the expected repayment required by bank i to break even. Indeed bank i anticipates that it will cash the equilibrium bid $P_N q_i$ paid by the healthy rival who wins the auction or, when all incumbents are failing - probability $(1-p)^N$ - the equilibrium bid $P_N q_i - E$ paid by the winning outsider.

At date 0 firm i chooses q_i to maximize (13) for given equilibrium capacities $\hat{q}$ set by rival incumbents. The symmetric subgame equilibrium capacity is reported in the following:

Proposition 2 *When at least two outsiders participate in the auction for the failing (incumbent) firms' productive assets, the symmetric equilibrium capacity when $N \in [2, \infty)$ (incumbent) firms are present at date 0 is*

$$\hat{q} = \frac{S - c}{b(N+1)}. \tag{14}$$

Proof. In Appendix A.2. ■

Proposition 2 proves that our model reduces to the standard Cournot case, similarly to the case of $p = 1$, when there are at least two outsiders willing to bid for the PAs of the failing incumbent firms. As a result, $\hat{q}$ is monotonically decreasing in N. Setting $p = 1$ in Figure 1 provides a graphical representation of $\hat{q}$. Note that $\hat{q}$ is positive for any admissible value of the parameters. This means that incumbent firms always invest.

As in Section 4 we are interested in calculating the equilibrium credit to incumbent firms at date 0, denoted by $\hat{L}$, when there are outsiders willing to bid for the PAs at date 1/2. Its definition is equivalent to (10) where $\hat{q}$ replaces q^*. Not surprisingly, $\hat{L}$ is monotonically decreasing in N and it is zero when N

is large. In that case, $c\hat{q}$ is lower than M; hence, incumbent firms have enough cash to finance the whole investment.[8]

Interestingly, the potential favorable effect of increasing the number of incumbents on firms' profits disappears here. The intuition is as follows. As explained in the case without outsiders, such a favorable effect lies in the fact that the PAs of failing firms are valuable only when at least two rivals are healthy, the probability of which is positively affected by N. Put differently, a greater number of competitors reduces the risk of the bank not recovering a positive value for the collateralized PAs of their failing clients. Obviously, this risk disappears when there are outsiders willing to bid for the PAs. As a result, the standard negative effect of a larger number of rivals on the equilibrium price and, in turn, on the equilibrium capacity and credit, dominates here.[9]

Before proceeding, we provide a comparison between the equilibrium investment and credit without outsiders (q^* and L^*) and the corresponding values when outsiders are present ($\hat{q}$ and $\hat{L}$), restricting our attention to the case where the four values are positive.

Proposition 3 *The equilibrium investment and the equilibrium credit are lower when no outsiders participate in the auction for PAs. In symbols,* $(0 <)\, q^* < \hat{q}$ *and* $(0 <)\, L^* < \hat{L}$.

Proof. In Appendix A.3. ■

The existence of outsiders enhances the resale value of PAs by increasing the number of states in which there is a positive liquidation value for PAs. As a result, both the equilibrium investment and the equilibrium credit augment compared with the case with no outsiders.

6 Predictions

The model presented in the previous sections provides predictions on how the investment behavior and financial decisions of firms are affected by the structure of the product market where firms operate.

First, we focus on the investment behavior. According to Proposition 1, firms may decide not to invest in capacity when no outsiders are willing to bid for the second-hand PAs. Indeed, q^* can be either zero or positive depending on the values of p and N. On the contrary, firms always invest when there are outsiders. Indeed, $\hat{q}$ is positive for any values of p and N according to Proposition 2. Overall, we can make the following prediction:

Prediction 1 *The probability that a firm invests is lower when there are no outsiders willing to participate in the auction for PAs.*

[8] Following a proof similar to that in Appendix B.3, one can prove that the equilibrium capacity is still $\hat{q}$ when firms are self-financed and there are at least two outsiders.

[9] For the sake of completeness, we briefly discuss the case where there is only one potential entrant in the market. The equilibrium capacity becomes

$$\max\left\{0, \frac{\left[1-(1-p)^N\right]S-c}{b\left[2+(N-1)\right]\left[1-(1-p)^N\right]}\right\}. \qquad (a)$$

Similarly to q^*, computed in Proposition 1, there is an inverted U-shaped relation between (a) and N, provided that p is not close to 1. The complete proof is available upon request.

We then turn our attention to the use of bank debt for firms that have decided to invest. We thus focus on the scenario where $q^* > 0$ and discuss the relation between the percentage of the investment financed with bank debt and PMC. Relying on Proposition 2 we can state that $\hat{L}$, if positive, is always decreasing in N when outsiders are present. By contrast, when outsiders are absent L^*, if positive, may be increasing or decreasing in N, as written in Proposition 1. These two results can be restated in the following prediction:

Prediction 2 *For a given probability of success, p, the percentage of the investment financed with bank debt does not increase in PMC when there are outsiders willing to participate in the auction for PAs. By contrast, such a percentage can be either increasing or decreasing in PMC when there are no outsiders.*

We also mention two results related to Proposition 3. First, Proposition 3 states that $q^* < \hat{q}$. This implies that inequality $cq^* > M$ is less likely to hold than inequality $c\hat{q} > M$, ceteris paribus. Accordingly, we can state that the probability that an investing firm resorts to bank debt is lower when outsiders do not participate in the auction for PAs. Second, Proposition 3 states that $L^* < \hat{L}$, when $L^* > 0$ and $\hat{L} > 0$. This means that the percentage of investment financed with bank debt is lower when outsiders do not participate in the auction for PAs.

7 Empirical Test

Any empirical strategy to test if the data support our predictions in Section 6 requires the use of information on the entire population of firms, those investing as well as those not investing, those financing their investments by issuing new collateralized bank debt as well as those that are fully self-financed. Limiting our attention to firms that have bank debt would result in silence about their investment and financing behavior. Moreover, in order to assess the plausibility of our predictions, the empirical relations between the degree of PMC and the investment and financing decisions should be allowed to differ between the cases in which the pool of participants in the auction includes or excludes outsiders willing to bid for the PAs. Finally, when moving from the theoretical model to the empirical model, it must be recognized that additional sources of observed and unobserved heterogeneity can also play a role in the actual choice of investment and its mode of financing. In fact, not all firms facing similar levels of PMC, the same probability of succeeding, the presence of outsiders and self-financing capacity will invest, and not all firms that invest will apply for a bank loan.

For these reasons, in our empirical exercise, we use a representative sample of SMEs for which the use of bank financing is crucial, opt for an econometric model that distinguishes between investment and financing decisions, consider flexible functional forms for the effects of the PMC, and condition upon a large set of other factors that may affect the firms' choices.

7.1 The Data

Our empirical test is based on information gathered in the Survey on Italian Manufacturing Enterprises run by Unicredit Bank Group. The 10th wave selects a representative sample of the Italian manufacturing limited companies with a turnover in 2006 of at least 1 million euro and 10 employees. All the companies with more than 500 workers are included in the sample, while smaller firms are drawn at random according to a stratified sampling scheme, with (80) strata defined on the basis of 5 size classes of employment, 4 territorial areas and 4 Pavitt sectors (see UniCredit Corporate Banking, 2008). The companies are contacted and interviewed by phone (CATI mode) or can self complete the questionnaire and hand in by email or fax. Each company is asked to provide data for the years 2004-2006, in particular, whether it has invested in the past three years, the nature of its investments and how it has been financed. This information is then matched with the company accounting records taken from Bureau van Dijk - AIDA for the years 2000-2006. Moreover, we know the location of the companies and a detailed description of their core business so that for each company we can recover the competitive environment with reference to its local product and credit markets.

The use of data on Italian manufacturing firms is particularly appropriate in our case. In fact, these companies are mostly small or medium enterprises with almost no direct access to financial markets; they form an entire population of firms for which bank credit is crucial.[10] The survey provides information on equipment and machinery purchases, i.e., assets with a high level of specificity, and how these purchases were financed. We have enough information on the mode of financing to be able to identify with precision the fraction of investment financed with medium- to long-term (ML, henceforth) bank debt (referred to as L), a credit contract typically requiring collateral.[11]

Unfortunately, we do not have information either on the presence of collateral related to the debt contract or on the type of collateral, which could be real estate or any other type of bank guarantee.[12]

The lack of accurate data on collateral may induce attenuation bias in our estimates of the effect of the PMC on the use of bank debt, as the resale value of some of the assets used as collateral are not affected by PMC. As a consequence, if we were to find any supporting evidence in favor of a collateral channel, we could consider it to be a lower bound to the true effect should we observe the true collateral.

The degree of PMC is captured by the Herfindahl Index (referred to as H), computed on the distribution of employees among firms operating in the same local market, which in turn is defined by the combination of 2-digit ATECO industry code and the province where the company is located. The adopted empirical definition of the relevant market, on the one hand must ensure sufficient variability in the PMC's measure, which is necessary for the estimation exercise, on the other hand should not unduly restrict the set of rivals in the product market, losing the economic meaning of the chosen PMC indicator. The balance between these two requirements is achieved by combining a broad definition of the manufacturing sector of reference (21 2-digit ATECO codes) with a territorial scope limited to the province (102 provinces). We follow the procedure suggested by Schmalensee (1977) using data published by the Italian National Institute of

[10] Notice that direct access to the bond market or to venture capital finance is extremely difficult for Italian SMEs, and in fact we do not observe it in our sample. Furthermore, we exclude from our definition of medium to long term bank debt any form of subsidized credit, while we include equipment leasing contracts.

[11] Firms' total leverage would not be as useful for our empirical analysis. The total stock of debt, cumulated over the past years and issued for many different reasons by the company, can hardly be associated to a specific investment. As a matter of fact, the association between the specific investment and the way it has been financed is crucial for our purpose: purchases of equipment and machinery might reveal that those purchased assets will be used as collateral in the credit contract.

[12] For investment in land and real estate, redeployment costs are relatively low and it can be easily argued that in case of project failure these assets are attractive for all firms, regardless of their product specialization. In terms of our model, it is as if there are always outsiders participating in auctions for land and real estate assets.

Statistics (ISTAT) on the distribution of plants at provincial level in 2004. These employment data cover all the plants in the area, regardless of the size (in terms of turnover and employment) and the legal form of the companies. They provide a measure of the local PMC that accounts for the presence of a multitude of micro-entreprises which characterizes the Italian manufacturing sectors. As robustness check, we compute H based on the turnover of limited companies (thus excluding the micro-enterprises for which accounting data are not available) and consider the possibility that PMC is simply captured by the number of firms in each local market; those alternative measures of PMC do not modify the main conclusions of our analysis.

In addition, each surveyed company is asked whether all main competitors are located within the same region of the company. We use this answer for its implications on the presence of outsiders willing to bid for PAs in the event of a firm's liquidation. A positive answer reveals that the firm operates in a market where only insiders are interested in bidding in case of liquidation of PAs. Accordingly, we refer to the binary variable Ins, which equals 1 if the answer is positive, implying the absence of outsiders, and zero otherwise. As robustness check, we experiment an alternative definition of Ins which equals 1 if all main rivals are located in the same province of the company, and zero otherwise; this change does not alter the main results.

To control for firms' heterogeneity, we introduce variables capturing their main characteristics. A first set of explanatory variables describes the size, financial structure and profitability of the firm at the beginning of the reference period, i.e., at the end of 2003. More specifically, from accounting records we include information to control for firm size (measured as (*log of*) *turnover* and (*log of*) *number of employees*), *leverage* (defined as the ratio of total debt over total assets), a measure of capital intensity (measured as (*log of*) *fixed assets over turnover*), a measure of new equity injections (measured as *change in shareholders funds over total assets*) and a profitability indicator (*ROA*).[13] We also control for firm age with a dummy variable that identifies young firms (*Less than 10 years*).

The probability of default plays an important role in the theoretical model. Although we do not have an observable counterpart of the probability of default, the set of firms' specific explanatory variables includes all of the constituents of the *z-score* (Altman, 2002), a measure of company's riskiness considered to be a predictor of the probability of default. We therefore indirectly control for the overall solvency of the firm. We also control for how easy access to alternative sources of finance is, by including two dummy variables to indicate whether the company is listed in the stock market (*Listed*) and whether it is part of a larger industrial group (*Part of a group*).

To account for the supply conditions of the local credit markets, we consider the degree of competition in the local banking sector measured by the Herfindahl Index on bank branches within the province where the company is located (*Herfindahl Index local credit market*).[14]

We also control for the potential role of industrial districts. When the degree of PMC is measured by the index of concentration, low levels of H may be associated with the presence of a multitude of small enterprises that do not actually compete with each other. This is typically the case for industrial districts, where PMC

[13] Due to data limitation, we could not retrieve the information on employees from AIDA and we had to rely on the number of employees in 2004 as self-reported in the survey.

[14] This information is borrowed from Cerasi et al. (2009) where the market shares are computed using the number of branches of individual banks in each local market.

is softer, because companies cooperate along several dimensions, for example in R&D joint ventures and worker networks. In these markets, banks may be willing to supply credit to firms, because they envision greater profitability, which potentially creates a negative correlation between H and the incidence of new bank debt L. To control for this confounding factor, we add the dummy variable *Part of an industrial district*, which equals 1 when the firm is active in the same sector of the industrial district of the area and zero otherwise.

Table 1 provides a description of the structure of our sample and of the explanatory variables. Starting from the 5,137 companies surveyed, we are left with 3,433 firms due to missing values for some of the relevant variables. Approximately 27.6% of these companies did not invest in equipment and machinery in the period 2004–2006. Among the 2,486 investing firms, 50.8% did not resort to any ML bank debt, $L = 0$, 29.8% used some debt, $L \in (0, 1)$, and the remaining 19.4% of firms relied exclusively on ML bank debt, $L = 1$.

Table 1 here

At the end of 2003 the companies in our sample had an average turnover approximately 22.4 million of euros, with those not investing being the smallest ones; similar information can be derived from the number of employees. The ROA was approximately 4%, with an overall leverage above 60%. The vast majority of companies are independent companies, not part of a group, and older than 10 years. It is therefore a sample of relatively large and old firms within the set of Italian SMEs. An analysis of their ATECO industry codes shows that these businesses mainly operate in traditional sectors. 29.7% of firms that do not invest in the period 2004-2006 have rivals all located within the boundaries of their region, i.e., $Ins = 1$. This percentage drops to less than 22% among those investing. The concentration degree in the local product market of the investing companies is similar to those not investing, with a slightly lower concentration for those investing and fully financing the investment with debt. Finally, the degree of concentration in the local banking market is similar between investing companies and those that have not invested.

7.2 The Econometric Model

Given the type of data available and the nature of the investment and financing decisions, a suitable econometric model for the problem at hand should combine the use of discrete and continuous dependent variables, taking into account the partial observability of the choice to resort to bank debt. In fact, we observe the choice to invest and, conditional on that, the fraction of the investment financed by ML bank debt. Both are outcomes of the interaction of demand and supply conditions in the credit market that are not explicitly modelled. We therefore abstain from giving a causal interpretation to our results, while restricting the analysis to testing the predictions of our theoretical model.

We assume that for each company i, operating in industry j and province p, the desired (unobservable) investment in PAs $\tilde{a}_{ijp}$ and the corresponding level of debt $\tilde{d}_{ijp}$ are described by the equations

$$\tilde{a}_{ijp} = \boldsymbol{x}^{a\prime}_{ijp}\boldsymbol{\beta}_a + Ins_{ijp}\delta_{a1} + H_{jp}\delta_{a2} + (Ins_{ijp} \times H_{jp})\,\delta_{a3} + \boldsymbol{z}'_j\boldsymbol{\gamma}_a + \varepsilon^a_{ijp}, \tag{15}$$

$$\tilde{d}_{ijp} = \boldsymbol{x}^{d\prime}_{ijp}\boldsymbol{\beta}_d + Ins_{ijp}\delta_{d1} + H_{jp}\delta_{d2} + (Ins_{ijp} \times H_{jp})\,\delta_{d3} + \boldsymbol{z}'_j\boldsymbol{\gamma}_d + \varepsilon^d_{ijp}, \tag{16}$$

where $\boldsymbol{x}_{ijp}^{a}$ and $\boldsymbol{x}_{ijp}^{d}$ are the vectors of firm characteristics previously described, $\boldsymbol{z}_j$ is the vector of industry dummies based on ATECO codes, and ε_{ijp}^{a} and ε_{ijp}^{d} are correlated stochastic components accounting for unobservable characteristics. More specifically, we assume that the bivariate random variables $\left(\varepsilon_{ijp}^{a}, \varepsilon_{ijp}^{d}\right)$ are identically distributed as standardized bivariate normals with correlation ρ, independent across companies operating in different industries or provinces; but possibly correlated across firms in the same local product market jp.

The system of equations (15-16) explicitly recognizes the correlation between the investment and financing decisions, it leaves all the variables to have different effects on the desired investment ($\tilde{a}_{ijp}$) and the level of ML debt ($\tilde{d}_{ijp}$), and it allows the impact of the PMC measured by H_{jp} to differ between the case in which the main rivals are all located within the boundaries of the region ($Ins_{ijp} = 1$) and when they are also external to the region. More specifically, the parameter δ_{a3} associated to the interaction term ($Ins_{ijp} \times H_{jp}$) captures the difference in the impact of H_{jp} on $\tilde{a}_{ijp}$ when $Ins_{ijp} = 1$ and when $Ins_{ijp} = 0$. A similar role is played by δ_{d3} in equation (16).

The estimation of the system (15-16) has to account for the fact that we do not have reliable information on the exact amount of the investment in equipment and machinery and we do not know the amount of debt. What we observe is whether a firm has undertaken an investment and, only for investing firms, the choice of the mode of financing and the percentage of investment financed with ML bank debt. In symbols, we observe a dummy variable A_{ijp} that equals 1 when the firm invested and zero otherwise, and a variable D_{ijp} that is observed only when $A_{ijp} = 1$ and takes value 1 if the company uses ML bank debt to finance its investment and zero otherwise. Formally, the value and observability of the two dichotomous variables are described by the following rule

$$D_{ijp} = \begin{cases} \mathbf{1}\left(\tilde{d}_{ijp} > 0\right) & if \quad A_{ijp} = \mathbf{1}\left(\tilde{a}_{ijp} > 0\right) = 1 \\ not\ observed & if \quad A_{ijp} = \mathbf{1}\left(\tilde{a}_{ijp} > 0\right) = 0 \end{cases}$$

where $\mathbf{1}(.)$ is an indicator function that equals 1 whenever the condition inside brackets holds true and 0 otherwise. We therefore apply a probit model with sample selection to explain the joint decision on whether to invest and resort to ML bank debt (also referred to as the extensive margin of the financing decision).

For those companies that invest and resort to new ML bank debt (i.e., $A_{ijp} \times D_{ijp} = 1$), the fraction of the investment financed with ML debt (L_{ijp}) is also available in the dataset. Such a percentage lies in the interval $(0, 1]$, which suggests the adoption of a tobit model to account for the right censoring. We therefore assume that for those companies with $A_{ijp} \times D_{ijp} = 1$ the latent incidence of the variable "new" debt $\tilde{L}_{ijp}$ is determined by the following equation

$$\ln \tilde{L}_{ijp} = \boldsymbol{x}_{ijp}^{l\prime} \boldsymbol{\beta}_l + Ins_{ijp}\delta_{l1} + H_{jp}\delta_{l2} + \left(Ins_{ijp} \times H_{jp}\right)\delta_{l3} + \varepsilon_{ijp}^{l} \tag{17}$$

with $\varepsilon_{ijp}^{l} \mid \left(\boldsymbol{x}_{ijp}, A_{ijp} \times D_{ijp} = 1\right) \sim N\left(0, \sigma^2\right)$, where $\boldsymbol{x}_{ijp} = \left(\boldsymbol{x}_{ijp}^{a\prime}, \boldsymbol{x}_{ijp}^{d\prime}, \boldsymbol{x}_{ijp}^{l\prime}, I_{ijp}, H_{ijp}, \boldsymbol{z}_j^{\prime}\right)^{\prime}$ is the vector of all of the covariates previously described and included in the model. The percentage of the investment financed with new ML (also referred to as the intensive margin of the financing decision) is determined by

$$\ln L_{ijp} = \begin{cases} \ln \tilde{L}_{ijp} & \text{if } \ln \tilde{L}_{ijp} < 0 \\ 0 & \text{if } \ln \tilde{L}_{ijp} \geq 0 \end{cases} \tag{18}$$

Writing the joint likelihood function for the triple $(A_{ijp}, D_{ijp}, \ln L_{ijp})$ is straightforward as the problem breaks into two separate models: a probit model with sample selection on the full sample and a tobit model on a limited set of observations, i.e., those for which $A_{ijp} \times D_{ijp} = 1$, to study the intensive margin of financing decisions. Altogether, we use a generalization of the two-part model suggested by Duan et al. (1983) in which the first part is a probit model with sample selection (instead of a standard probit) and the second part is a tobit model (instead of a standard linear regression model).

We estimate the parameters of interest via pseudo maximum likelihood to account for possible correlation among companies operating in the same industry and province. Although extremely manageable, the model can address the partial observability issue without imposing restrictions on the effect of the variables on the extensive and intensive margins of the financing decision. Yet, the main motivation for adopting this modelling strategy is the interest in studying the effect of the PMC not only on those companies that have had access to credit, but also on those that could have access but did not. In fact, combining the different components of our model we can compute the expected percentage of investment financed with new ML debt for a generic company randomly chosen from anyone within the full population of firms as follows:

$$E\left[L_{ijp}|\boldsymbol{x}_{ijp}\right] = \Pr\left(A_{ijp} \times D_{ijp} = 1|\boldsymbol{x}_{ijp}\right) E\left[L_{ijp}|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}\right] \tag{19}$$

with

$$\begin{aligned} E\left[L_{ijp}|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}\right] = \exp\Big(E\Big[\ln \tilde{L}_{ijp}|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}\Big] + \tfrac{\sigma^2}{2}\Big) \Pr\Big(\ln \tilde{L}_{ijp} < 0|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}\Big) \\ + \Pr\Big(\ln \tilde{L}_{ijp} \geq 0|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}\Big)\,. \end{aligned}$$

Equation (19) implies that for any company i, the expected level of L_{ijp} is determined by the interplay of two components: the first term is the occurrence that the company invests and finances this investment with debt, while the second term is the percentage of new borrowings in case the company fits the first condition. We can also estimate the effect of a (marginal) variation of H_{jp} on $E\left[L_{ijp}|\boldsymbol{x}_{ijp}\right]$ for any of the SMEs in the population as a function of the parameters in both parts of the model, more specifically:

$$\begin{aligned} \tfrac{\partial E[L_{ijp}|\boldsymbol{x}_{ijp}]}{\partial H_{jp}} = \tfrac{\partial \Pr(A_{ijp}\times D_{ijp}=1|\boldsymbol{x}_{ijp})}{\partial H_{jp}} E\left[L_{ijp}|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}\right] \\ + \tfrac{\partial E[L_{ijp}|A_{ijp}\times D_{ijp}=1, \boldsymbol{x}_{ijp}]}{\partial H_{jp}} \Pr\left(A_{ijp} \times D_{ijp} = 1|\boldsymbol{x}_{ijp}\right). \end{aligned} \tag{20}$$

Equation (20) makes evident the value of using data reporting information on either investment or credit, instead of data from the credit register. If we used data from the credit register, i.e., reporting information on credit contracts, that is rich in details about the debt contract, collateral and borrowers' characteristics, we would miss information on companies that did not invest or that self-financed their investments. With those data, we would have been able to estimate $E\left[L_{ijp}|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}\right]$ but not $\Pr\left(A_{ijp} \times D_{ijp} = 1|\boldsymbol{x}_{ijp}\right)$, and therefore we could not evaluate the marginal effect (20), and the results of our model could not be extended to the entire population of companies. Furthermore, equation (20) shows that changes in PMC can be relevant for the access to credit for SMEs even when such changes do not alter the indebtedness level of current borrowers. This point, which is potentially relevant from the policy perspective, is missed when focusing on data reporting information on borrowers only. Finally, despite the linearity assumptions of the equations (15), (16) and (17) with respect to the PMC indicator H_{jp}, neither $E\left[L_{ijp}|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}\right]$

nor $E[L_{ijp}|\boldsymbol{x}_{ijp}]$ are linear functions of H_{jp}: the effect of PMC on the percentage of investment financed with debt, L_{ijp}, depends upon the presence of outsiders potentially willing to bid for the PAs, the dummy Ins, other company characteristics, x_{ijp}, and the level of H_{jp} itself.

The econometric identification of all of the parameters of interest is granted by the non-linearity of the model. Yet, in order to further improve the identification of the model, we add industry dummy variables z_j in the two equations that measure the choice to invest and resort to debt; these dummy variables are instead excluded from the other equation, i.e. that related to the percentage of investment financed with ML debt. For the same reason, we include the (log of the) ratio of fixed assets to sales in $\boldsymbol{x}_{ijp}^a$ but not in $\boldsymbol{x}_{ijp}^d$ and $\boldsymbol{x}_{ijp}^l$. In other words, we assume that capital intensity (i.e., the ratio of fixed assets to turnover) affects the investment decision, but not the amount of debt, conditional on having invested and all of the other observable characteristics.

7.3 Estimation Results

The pseudo-maximum likelihood estimates of the probit model with sample selection and the tobit model are presented in Appendix C. The estimates of the parameters of the equations (15), (16) and (17) shown in Table C.1. in the Appendix measure the impact of the covariates on the mean of the three latent variables $\left(\tilde{a}_{ijp}, \tilde{d}_{ijp}, \ln \widetilde{L}_{ijp}\right)$. Yet, due to the non-linearity of the model, their relation with the observable variables $(A_{ijp}, D_{ijp}, \ln L_{ijp})$ is difficult to assess. For this reason, we focus here on the effect of the covariates on the observable outcomes, captured by the percentage changes shown in Table 2**.** The effect of a change of a specific variable is computed holding the value of all the other variables constant at their sample mean provided in Table 1; we consider discrete changes (from 0 to 1) for the binary variables and a 1% change for the continuous covariates.

Table 2 here

We start by commenting on the effects of the covariates $\left(\boldsymbol{x}_{ijp}^{a\prime}, \boldsymbol{x}_{ijp}^{d\prime}, \boldsymbol{x}_{ijp}^{l\prime}\right)$ related to the size, financial structure and profitability of the firms. Column (1) refers to the changes in the probability to invest, $\Pr(A_{ijp} = 1|\boldsymbol{x}_{ijp})$. According to the coefficients in column (1), the probability to invest in equipment and machinery between 2004 and 2006 increases with profitability, number of employees, ratio of fixed assets over turnover and leverage at the end of 2003. Ceteris paribus, younger companies are less likely to renew or expand their equipment. Being part of a group of companies, being in an industrial district, being listed in the stock market and the competition in the local credit market do not significantly affect the probability of investing by an "average" company.

Column (2) reports the effect of variables affecting the probability of resorting to ML bank debt given that the firm has invested, i.e., $\Pr(D_{ijp} = 1|A_{ijp} = 1, \boldsymbol{x}_{ijp})$. The probability of using ML bank debt to finance an investment in equipment and machinery during the period 2004–2006 increases with the amount of leverage at the end of 2003 (with an elasticity of 0.44) and it is remarkably reduced (-19%) for companies that are part of a group and can therefore rely on intra-group transfers. A lower concentration index in the local banking market, increases the likelihood that the investment will be financed with bank debt.

Column (3) refers to the effects of the variables on the joint probability that firms invest and issue new ML debt, $\Pr(A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}) = \Pr(D_{ijp} = 1 | A_{ijp} = 1, \boldsymbol{x}_{ijp}) \times \Pr(A_{ijp} = 1 | \boldsymbol{x}_{ijp})$: the relative change of the joint probability $\Pr(A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp})$ in column (3) is the sum of the coefficients in columns (1) and (2). It is easy to observe that the positive effect of profitability and number of employees on the joint probability is mainly attributable to their effects on the probability to invest, while the increase in the probability of issuing new ML debt associated with a higher leverage drives an increase in the joint probability. Sometimes the two effects compensate for each others. For instance, the negative effect in column (2) of an increase in the degree of concentration in the local banking market is compensated by the positive effect in column (1) so that their combination cancels out in the probability of the joint event.

In column (4) we find the estimated effects on the percentage of the investment financed with ML debt, $E[L_{ijp} | A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}]$, which shows what follows. Among companies resorting to bank debt, the larger ones (in terms of turnover and number of employees) are those that rely less on debt, together with those that had capital injections by their shareholders prior to the decision to invest, and those facing greater concentration in their local banking markets.

Finally, it is interesting to remark that the estimated correlation between the two stochastic terms of equations (15) and (16), ρ, is equal to -0.5: see Table C.1. in the Appendix. Although not precisely estimated, the negative sign of the parameter indicates that the unobservable components of the propensity to invest and financing it with new ML bank debt are inversely correlated. Ceteris paribus, the greater the probability to invest, the smaller the probability to finance it with ML bank debt. This evidence suggests that Italian SMEs prefer to fund their investments with other sources of finance, mainly self finance, rather than issuing ML debt. This result can be explained by the existence of a premium on external finance for SMEs, as discussed in the survey on cross-country evidence by Beck and Demirguc-Kunt (2006).

We now turn our attention to the most relevant variables for our analysis, namely the Herfindahl Index, H, which describes the level of competition in the product market, and the dummy variable Ins, related to the presence of outsiders willing to acquire PAs in the event of liquidation.

Column (1) shows that the probability to invest is on average 10.3% lower for companies without outsiders willing to bid for PAs. This evidence supports Prediction 1. The same column shows that, on average, a 1% increase in the Herfindahl Index of the product market, H, is associated with a 0.01% decrease in the probability of investing when there are outsiders (i.e., $Ins = 0$). To appreciate the economic relevance of this result, we complement the information provided in the table by considering what happens when H increases from the first to the third quartile of its distribution, keeping all of the other variables at their averages. This is equivalent to the virtual exercise in which the "average company" is somewhat moved from a very competitive market to one of the least competitive markets. The change of H from 0.0015 to 0.0089 is associated with a statistically significant reduction of 0.25 in the probability of investing when there are outsiders (i.e., $Ins = 0$).

The results in column (2) of Table 2 show that neither the presence of outsiders, nor the degree of PMC affects the probability of issuing new ML debt conditional on having invested. The combination of the results in columns (1) and (2) allows us to claim that the degree of PMC has no significant effect on the probability of issuing new ML debt; however, column (3) indicates that the absence of outsiders has a negative effect (-12.8%) on the joint probability of investing and issuing new ML debt, which is the sum of the effects in column (1) and (2).

A 1% increase in our measure of PMC, the Herfindahl Index in the product market H, in column (4), is associated with a 0.012% reduction in the percentage of investment financed with ML bank debt, and this estimated effect is significantly different from zero. Our theoretical model suggests that there might be a difference in the equilibrium share of bank credit, based on whether the firm has rivals outside the local market. When we compute the effect separately for companies with and without competitors outside their local market we do find evidence consistent with Prediction 2. The elasticity of L to H is equal to -0.043 (and significantly different from zero) for companies with only local rivals, while it is statistically not different from zero when there are outsiders willing to bid for PAs. Greater PMC explains an increase in the share of new ML bank debt when the pool of bidders is restricted to rivals in the same local market. The estimates of the marginal effects $E\left[L_{ijp}|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}\right]/\partial H_{jp}$ do not change remarkably with changes of H within its observed range of variation, but increasing the degree of competition by reducing H from the third to the first quartile is associated with an increase of 0.94 (*std.err.* = 0.28) in the predicted value of the percentage L for firms with insiders only, and of 0.02 (*std.err.* = 0.11) when there are outsiders. As mentioned, this result is consistent with Prediction 2. It should be noted however, that although statistically significant, an increase in the degree of competition in the product market is accompanied by a small change in the percentage of investment financed with new ML bank debt.

When an average company switches from a market with outsiders, $Ins = 0$, to one without outsiders, $Ins = 1$, the effect on the percentage of the investment financed with ML bank debt is not significant. This result does not conform with the result in Proposition 3 concerning L.

Our empirical model can be exploited to cast evidence from the endogenously self-selected set of companies that invest and issue ML bank debt to the entire population of companies. This allows us to measure the potential impact on bank credit to SMEs of a policy that increases the degree of PMC or opens the market of PAs to outsiders.

According to equation (20) the relative change of $E\left[L_{ijp}|\boldsymbol{x}_{ijp}\right]$ induced by a change in any of the observable variables in column (5) is given by the sum of the values in column (3) and (4) in Table 2. By summing the coefficients in the first row, we see that, although a rise in H has a negligible effect on the issuance of new ML bank debt, excluding outsiders as potential bidders for PAs has a negative effect (-8%) on the percentage of the investment financed with new ML bank debt by the average firm. Its point estimate for the average firm is economically sizeable, although we cannot statistically reject the hypothesis that such effect is negligible. It is interesting to observe that this effect originates from the investment equation (15): it is the higher propensity to invest when operating in markets where rivals are also outside the region that explains the result.[15] The lack of precision for the effect on $E\left[L_{ijp}|\boldsymbol{x}_{ijp}\right]$ is instead due to the uncertainty about the effect on $E\left[L_{ijp}|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}\right]$.

In conclusion, we can summarize our evidence as follows:

[15] As mentioned in the introduction, this evidence contrasts with results in Frésard and Valta (2014) who find a positive effect on investment due to the entry threat of a reduction in import tariffs. Our results pertain to SMEs instead of large firms; in addition we use a stricter definition of investment compared to them to focus on purchases of machinery and equipment.

- the probability of investing is on average 10.3% smaller for companies operating in local markets without outsiders, i.e. potential entrants in the second-hand market for PAs;
- when we focus on the firms that invested and raised debt, the percentage of the investment financed with ML debt is increasing in PMC (lower Herfindahl Index) when all of the rivals are within the same local market; this effect is close to zero when there are outsiders;
- when we consider all the firms, regardless of their investment and financing decisions, the percentage of the investment financed with ML debt decreases by 8% (although not statistically significant) when outsiders are absent; this result is driven by the negative (and statistically significant) effect on the probability to invest.

Overall, our model enables us to distinguish between two different notions of competition, rivalry among incumbents and that coming from potential entrants, referred to as "outsiders". The empirical analysis provides evidence that the existence of potential entrants can be more effective in terms of SMEs being able to invest and gain access to credit than an increase in the number of rivals in the local market. A fiercer competition in a local market without potential entrants has instead a small positive effect on the percentage of the investment financed by bank debt.

7.3.1 Robustness checks

To verify the robustness of our evidence in support of Predictions 1 and 2 we perform several checks. We propose alternative indicators for the PMC and the presence of outsiders potentially interested in the PAs auction, we consider the possibility that PMC could be better captured by a profitability rather than by a concentration index, and we account for the role of subsidized credit as part of the bank credit. All these changes do not alter qualitatively our main results, and are discussed in details in the remaining of this sub-section by referring to Table 3. For sake of brevity we show only the effects of variations in the PMC measure and Ins on the probability to invest and resort to ML bank debt (columns 1-3) and on the share of investment financed by ML bank debt (column 4). The estimated models include all the other covariates considered in the benchmark case and their effects remain basically unaltered.

Table 3 here

Dealing with measurement error in H. The benchmark measure of local PMC, H_{jp}, is estimated following Schmalensee (1977) on the basis of data published by 4 size classes of employment. The utilization of aggregated data may induce a relevant measurement error in our key variable. In order to assess the robustness of our conclusions, we avoid to use the point estimate of the Herfindahl concentration index, and rely only on the ranking of the local product markets according to the H_{jp}. This means that instead of using H_{jp} in the model, we use three dummy variables which equal one only if the Herfindahl index of the local product market belongs to the second, third or fourth quartile of the entire distribution. If the measurement errors affecting the point estimate of H_{jp} are not so large to cause a significant miss-classification of the local markets in quartiles, then the use of a coarse indicator should reduce the impact of measurement errors on the estimates. The results show that the companies operating in the least competitive local market (that is, falling into the fourth quartile of the distribution) are those with the lowest percentage of new ML bank debt $E\left[L_{ijp}|Q_{ijp} \times D_{ijp}=1, \boldsymbol{x}_{ijp}\right]$. In particular, those in the least competitive markets and with only insiders bidding for PAs have a percentage of investment financed with new ML bank debt 15% lower than the other companies. This confirms qualitatively the results of the benchmark model.

Herfindahl index based on turnover. An alternative index of concentration can be computed using data on companies turnover. We exploit information available from the dataset AIDA, by Bureau Van Dijk, gathering registered balance sheet data. Italian public and private companies are obliged to deposit their balance sheet at the public register, while micro-entreprises and partnerships are not. With respect to the employment information, these data have the advantage to be accessible for public use at the individual level, but they do not cover the universe of active firms. We can therefore compute the Herfindahl index on the basis of the turnover reported in 2003 by each company operating in a specific industry and province. We thus replace the H_{jp} computed on aggregate employment data as in the benchmark model, with an index based on individual information on turnover. This change does not affect our main conclusions: the presence of outsiders has a major impact on the probability to invest and resort to ML bank debt, $\Pr\left(A_{ijp} \times D_{ijp}=1|\boldsymbol{x}_{ijp}\right)$; a 1% rise in the concentration index reduces by 0.08% the percentage of investment financed with ML bank debt $E\left[L_{ijp}|A_{ijp} \times D_{ijp}=1, \boldsymbol{x}_{ijp}\right]$ when there are only insiders willing to bid for PAs, leaving instead this percentage unaffected when there are outsiders.

Measuring PMC as the number of operating companies. In the theoretical model the degree of competition is fully captured by the number of companies operating in the product market. In the empirical exercise instead, we proxy PMC with measures of concentration in order to take into account not only the number of firms in the market, but also their relative size. We believe that, in practice, the Herfindahl index provides a better information on the degree of competition in the market. Yet it is more likely to be affected by measurement errors compared to the plain figure of the number of companies. We thus run a regression in which H_{jp} is replaced by (the log of) the total number of public and private companies operating in sector j in province p in 2003. A one percent change in the number of companies is associated to a 0.05% increase in the conditional expected percentage of investment financed with new ML debt, $E\left[L_{ijp}|A_{ijp} \times D_{ijp}=1, \boldsymbol{x}_{ijp}\right]$, if the pool of potential participant in the auction for PAs is limited to the insiders, while a similar change in the number of companies leaves the same percentage unaffected when there are outsiders, and the absence of outsiders considerably decreases the probability to invest. This evidence confirms our benchmark results.

Profitability and product market competition. The Herfindahl Index - no matter how it is computed - may not capture fully the degree of competition, as rivalry might not be correlated with concentration in market shares or the numerosity of the companies. In fact, we could not capture situations in which few large firms compete fiercly, as well as cases where collusion occurs in fragmented industries (see for instance Cetorelli, 1999, for a discussion of this issue). In the first case, we expect a higher degree of concentration to be associated with lower profitability, while in the latter a lower concentration index with higher profitability. In order to disentangle between concentration and competition measures, we enrich our benchmark model by including the average return on equity (ROE) for companies operating in the same local product market in 2003. This addition does not alter our results: the average ROE in the local product market does not affect significantly the use of ML bank debt to finance investment.

An alternative indicator for the presence of outsiders. In the benchmark case, the binary variable Ins equals 1 when all the rivals of the company are located in the same region of the company itself, and zero otherwise. The definition of Ins is based on the region of the rivals to better account for redeployment costs of second-hand equipment and machinery which are likely to be proportional to the distance between sellers and buyers. As a drawback, by doing so, we have a misalignment between the territorial reference of H and that of Ins. As robustness check, Ins is re-defined to be 1 when all the rivals of the company are located in the same province of the company itself, and zero otherwise. As a consequence of the reduction of the area, only 8.1% of the companies in the estimation sample have $Ins = 1$ (they are 23.7% with the original definition, see Table 1). The absence of rivals outside the local market reduces by 21.1% the probability to invest and resort to ML bank debt, $\Pr(A_{ijp} \times D_{ijp} = 1|\boldsymbol{x}_{ijp})$, a larger effect than in the benchmark case (-12.8%, see Table 2). Moreover, unlike that in the benchmark case, now the main reason of the drop is the change in the probability to resort to ML bank debt of the investing companies, rather than in the probability to invest. As in the benchmark case, a 1% increase in H_{jp} is associated with an overall 0.012% reduction in $E[L_{ijp}|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}]$, which, consistently with Prediction 2, is determined by a -0.092% drop for companies with only local rivals. In conclusion, the narrower definition of Ins at the provincial level enhances the estimated impact of both outsiders and PMC coherently with our theoretical model.

Subsidized credit. In our sample, about 15% of the investing companies have resorted to subsidized credit to finance their investments, that is ML debt with interest rates below the market rates, because of the existence of public policies to promote investment by SMEs. In our benchmark model we have excluded this fraction of debt from the definition of new ML bank debt considered as dependent variable. Indeed it may be the case that the role played by the collateral in subsidized contracts is marginal. When we include subsidized debt in the definition of ML bank debt, the estimated effect of the presence of outsiders is almost equivalent to that in our benchmark results. Looking at the effect of PMC, when including subsidized credit, a 1% increase of H is associated with a 0.029% reduction in the percentage of investment financed with ML bank debt $E[L_{ijp}|A_{ijp} \times D_{ijp} = 1, \boldsymbol{x}_{ijp}]$, that is a smaller effect - as expected - compared to the case in which subsidized debt is excluded (-0.043%).

8 Concluding Remarks

In this paper, we presented a model to relate credit conditions to PMC. To this end, we considered not only the standard effect of PMC on prices but also that on the resale value of PAs used as collateral in the loan contract. Because the resale value is enhanced by the PAs' liquidity, having more rivals in the industry and hence more potential buyers boosts the PAs' value in case of liquidation. However, more competition shrinks the price and the profits. As a result of this trade-off, the overall effect of PMC on the equilibrium share of investment financed with bank credit was shown to be non monotonic. Interestingly, this result depends crucially on the lack of firms outside the industry willing to bid for the PAs of distressed incumbents; when outsiders are present, the equilibrium share decreases with PMC.

The empirical analysis gauged the actual impact of PMC on the financial conditions of Italian SMEs. We provided evidence supporting our theoretical results: only companies without outsiders succeed in raising more bank debt to finance their investments when they face more PMC.

In this paper, we faced some limitations due to assumptions of analytical tractability and missing information in the data. In the theoretical model, we assumed that the negative shocks that initiate the distress are independent across firms. This assumption can be restrictive, because firms in the same product market are often exposed to common risk factors, and the result of Proposition 1 can be affected. Indeed, with high correlation across defaults, all firms are likely to be either healthy or in distress, hence the expected resale value of PAs shrinks. Yet, Cerasi and Fedele (2011) show that, in the absence of outsiders, the effect of PMC on bank credit can still be positive when correlation across defaults is considered. This means that ruling out systemic shocks does not affect the result of Proposition 1, at least from a qualitative point of view. A second restrictive assumption is that the probability of default is not affected by the degree of PMC. Indeed, tougher PMC can increase the likelihood of a default by shrinking profits. We leave to future research a model that endogenizes such a probability.

In the empirical analysis a limitation came from the lack of detailed information about the collateral associated to the loan. This specific information could be useful to gauge directly the collateral channel. For instance, if different degrees of PAs redeployability were observable, one could test whether the potential positive effect of PMC on the PAs' resale value is enhanced by lower PAs redeployability.

A Proofs

A.1 Proof of Proposition 1

Firm i's expected profits at date 0, expression (7), is computed as follows. With probability $(1-p)$ firm i defaults and makes zero profit. With probability p firm i gains at least $P_N q_i$ and repays r_i at date 1. In addition, firm i is healthy and earns the following extra-revenue

$$\sum_{H=0}^{N-1} \binom{N-1}{H} p^H (1-p)^{N-1-H} \frac{1}{H+1} P_N (N-1-H) q^* : \tag{A.1}$$

when H rivals are healthy (and $N-1-H$ rivals are in distress) - this occurs $\binom{N-1}{H}$ times, each one with probability $p^H (1-p)^{N-1-H}$ - firm i is awarded PAs of all distressed rivals with probability $\frac{1}{H+1}$. Summing up, firm i's expected profit is:

$$U_i = p (P_N q_i - r_i) + p \sum_{H=0}^{N-1} \binom{N-1}{H} p^H (1-p)^{N-1-H} \frac{1}{H+1} P_N (N-1-H) q^* - M, \tag{A.2}$$

where M is the opportunity cost of firm i's own funding.

To calculate the expected profits of bank i we first rely on the argument developed in Section 3 to sum up the equilibrium bids for a single failing firm's PAs:

$$v_N(1,H) = \begin{cases} 0 & \text{if } H = N-1, \\ P_N q^* & \text{if } H \in [1, N-2], \\ \varepsilon & \text{if } H = 0, \end{cases} \quad \text{and } v_N(0,H) = \begin{cases} P_N q_i & \text{if } H \in [2, N-1], \\ \varepsilon & \text{if } H = 1, \\ 0 & \text{if } H = 0. \end{cases} \tag{A.3}$$

Notation $(1,H)$ indicates that firm i plus H firms are healthy, whilst $(0,H)$ that firm i is failing and H firms are healthy. With probability p firm i is healthy, repays r_i but requires extra-borrowing to bid for the distressed rivals' PAs at unit price $v_N(1,H)$. With probability $(1-p)$ firm i fails, hence the bank seizes PAs and recovers the liquidation value $v_N(0,H)$. Finally there is the opportunity cost of borrowed funds $(cq_i - M)$. In symbols, the expected profits of bank i are

$$V_i = p\left[r_i - \sum_{H=0}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H}\frac{1}{H+1}(N-1-H)\,v_N(1,H)\right] \tag{A.4}$$
$$+(1-p)\left[\sum_{H=0}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H}\,v_N(0,H)\right]-(cq_i-M).$$

Substituting the equilibrium bids from $(A.3)$, bank i's expected profits can be rewritten as:

$$V_i = p\left[r_i - \sum_{H=1}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H}\frac{1}{H+1}P_N(N-1-H)\,q^* - (1-p)^{N-1}(N-1)\,\varepsilon\right] \tag{A.5}$$
$$+(1-p)\left[(N-1)\,p\,(1-p)^{N-2}\varepsilon + \sum_{H=2}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H}P_Nq_i\right]-(cq_i-M).$$

We solve $V_i = 0$ by pr_i and substitute the result into $(A.2)$. This gives (7) in the text, after remarking that

$$\sum_{H=2}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H} = 1-(1-p)^{N-1}-(N-1)\,p\,(1-p)^{N-2} \tag{A.6}$$

according to the Binomial density formula. Maximizing (7) with respect to q_i, when all rivals set their capacity at the equilibrium level q^*, and taking into account the non-negativity constraint on the capacity level yields the result of Proposition 1. ■

A.2 Proof of Proposition 2

The outsiders' equilibrium bids for each of the failing firm's PAs are

$$v_{N,O}(1,H) = \begin{cases} 0 & \text{if } H = N-1, \\ P_N\hat{q} & \text{if } H\in[1,N-2], \\ P_N\hat{q}-E+\varepsilon & \text{if } H=0 \end{cases} \quad\text{and } v_{N,O}(0,H) = \begin{cases} P_N\hat{q} & \text{if } H\in[2,N-1], \\ P_N\hat{q}-E+\varepsilon & \text{if } H=1, \\ P_N\hat{q}-E & \text{if } H=0, \end{cases} \tag{A.7}$$

where subscript O stands for outsider, $(1,H)$ indicates that incumbent firm i plus H incumbent firms are healthy, whilst $(0,H)$ that incumbent firm i is failing and H incumbent firms are healthy. Firm i's expected profit is as in $(A.2)$, with $\hat{q}$ instead of q^*. On the contrary, expected profit of bank i is given by $(A.4)$, with $\hat{q}$ instead of q^* and $v_{N,O}$ instead of v_N:

$$V_{i,O} = p\left[r_i - \sum_{H=1}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H}\frac{1}{H+1}(N-1-H)\,P_N\hat{q} - (1-p)^{N-1}(P_N\hat{q}-E+\varepsilon)\right]$$
$$+(1-p)\left[\sum_{H=0}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H}P_Nq_i-(1-p)^{N-1}E-(N-1)\,p\,(1-p)^{N-2}(E-\varepsilon)\right]-(cq_i-M).$$

Rearranging yields

$$V_{i,O} = p\left[r_i - \sum_{H=0}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H}\frac{1}{H+1}(N-1-H)\,P_N\hat{q}\right]$$
$$+(1-p)\left(\sum_{H=0}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H}P_Nq_i-(1-p)^{N-1}E\right)-(cq_i-M)$$

We solve $V_{i,O} = 0$ by pr_i and substitute the result into firm's i profit. This gives equation (13) in the text. Maximizing (13) with respect to q_i, when all rivals set their capacity at the equilibrium level $\hat{q}$, yields the result of Proposition 2. ■

A.3 Proof of Proposition 3

To prove that $q^* < \hat{q}$, we compare expressions (8) and (14). Consider the difference

$$q^* - \hat{q} = \frac{S-c}{b}\left\{\frac{1}{N+1-(1-p)^{N-1}\left[N+1+p(N-1)^2-2p\right]} - \frac{1}{N+1}\right\} \\ -\frac{S}{b}\frac{(1-p)^{N-1}[1+p(N-2)]}{N+1-(1-p)^{N-1}\left[N+1+p(N-1)^2-2p\right]}.$$

Being $S > 0$ and $b > 0$ we can multiply the above difference by $\frac{b}{S}$ without affecting its sign. We can therefore focus on

$$\frac{b}{S}\left(q^* - \hat{q}\right) = \frac{S-c}{S}\left(\frac{1}{(N+1)-(1-p)^{N-1}\left(N+1+p(N-1)^2-2p\right)} - \frac{1}{N+1}\right) \\ -\frac{(1-p)^{N-1}(1+p(N-2))}{\left((N+1)-(1-p)^{N-1}\left(N+1+p(N-1)^2-2p\right)\right)} \tag{A.8}$$

Consider the difference $(A.8)$ for $\frac{S-c}{S} \to 1$, i.e., the superior of the RHS:

$$\frac{1}{(N+1)-(1-p)^{N-1}\left(N+1+p(N-1)^2-2p\right)} - \frac{1}{N+1} \\ -\frac{(1-p)^{N-1}(1+p(N-2))}{(N+1)-(1-p)^{N-1}\left(N+1+p(N-1)^2-2p\right)}. \tag{A.9}$$

If $(A.9)$ is negative, then $q^* - \hat{q} < 0$. Expression $(A.9)$ can be rearranged as

$$\frac{p\left(N-1\right)\left(1-p\right)^N}{\left(N+1\right)\left\{\left(1-p\right)^N\left[N+1-p\left(1+2N-N^2\right)\right]-\left(N+1\right)\left(1-p\right)\right\}},$$

which is negative iff

$$\left(1-p\right)^{N-1}\left\{1-p+N\left[1+p\left(N-2\right)\right]\right\} < \left(N+1\right). \tag{A.10}$$

To see that inequality $(A.10)$ is fulfilled, note that the LHS of $(A.10)$ is decreasing in p, hence it reaches the maximum value of $N+1$ at $p=0$ and recall that $p \in (0,1]$. Therefore, $q^* - \hat{q}$ is strictly negative for any given admissible (p, N).

To prove that $L^* = 1 - \frac{M}{cq^*} < \hat{L} = 1 - \frac{M}{c\hat{q}}$, it is sufficient to rearrange inequality $1 - \frac{M}{cq^*} < 1 - \frac{M}{c\hat{q}}$ as $c\left(q^* - \hat{q}\right) < 0$. The latter inequality holds true given that $q^* - \hat{q} < 0$. ■

B Robustness of the Theoretical Model

We discuss the robustness of our theoretical results.

B.1 Capacity-constrained Quantity Competition

In the main analysis, healthy firms are assumed to produce at the maximum capacity level at date 1. We relax this hypothesis by allowing each healthy firm to set optimally the Cournot quantity at date 1. To this aim, we solve the following three-stage capacity-constrained quantity competition game: at date 0 each firm i sets simultaneously the capacity for its plant, the unit capacity cost being c; at date 1/2 the auction for the indivisible PAs takes place; at date 1 each healthy firm sets the Cournot quantity, the unit production cost being 0. We focus on pure-strategy subgame equilibria (SPNEs).

For simplicity, we consider self-financed incumbents, we disregard potential outsiders, and we let the unit capacity cost c belong to interval $\left[\frac{S}{2}, S\right)$. This is the parametric condition, computed in Appendix B.2, under which healthy firms bid for the PAs of all failing rivals. Here we simply describe the two SPNEs arising at date 0 when $N = 2$ and $N = 3$. The complete proof is available upon request.

N=2. When two firms are active at date 0, the SPNE is as follows. At date 0 the two firms set the symmetric capacity level $q_2^* = \max\left\{0, \frac{pS-c}{bp(4-p)}\right\}$. At date 1/2, the auction takes place when only one firm is healthy - probability $2p(1-p)$ - in which case the healthy firm buys the distressed rival's PAs at price ε. At date 1, the Cournot quantity produced by each healthy firm is q_2^* when both firms are healthy - probability p^2 - and $2q_2^*$ when there is only one healthy firm in the market - probability $p(1-p)$. This means that firms find it optimal to produce at the maximum capacity level, given by the capacity installed at date 0 plus the failing rival's capacity acquired at date 1/2.

N=3. When three firms are active at date 0, the SPNE is as follows. At date 0 the three firms set the symmetric capacity level $q_3^* = \max\left\{0, \frac{pS\left(1+p-p^2\right)-c}{2bp(3-p^2)}\right\}$. At date 1/2, with probability $3p^2(1-p)$, the two healthy firms bid $(S - 3bq_3^*)\, q_3^*$ to buy the distressed rival's PAs; with probability $3p(1-p)^2$ the only healthy firm buys both distressed rivals' PAs at price 2ε. At date 1, each healthy firm produces q_3^* when all firms are healthy; $\frac{1}{2}2q_3^* + \left(1 - \frac{1}{2}\right) q_3^*$ is the expected production when one rival is in distress, $\frac{1}{2}\left(1 - \frac{1}{2}\right)$ being the probability that firm 1 wins (loses) the auction; finally, each healthy firm produces $3q_3^*$ when it is the only in the market. This means that the firms find it optimal to produce at the maximum capacity.

In Figure B.1 we draw $q_2^* = \frac{pS-c}{bp(4-p)}$, solid curve, and $q_3^* = \frac{pS\left(1+p-p^2\right)-c}{2bp(3-p^2)}$, dashed curve, as a function of p after normalizing S and b to 1 and letting $c = 0.7$ as in Figure 1.

Figure B.1 here

Figure B.1 shows that: (i) both q_2^* and q_3^* are zero when p is relatively small; $q_2^* < q_3^*$ when p takes intermediate values; $q_2^* > q_3^*$ when p tends to 1. These findings are in line with the comparative statics results regarding the equilibrium capacity (8). As a result, parametric conditions exist (i.e., intermediate values of p) where an increasing number of firms active at date 0 affects investment positively (i.e., $q_2^* < q_3^*$) even when healthy firms are allowed to set optimally the Cournot quantity at date 1.

B.2 Bidding for all PAs on Sale?

The equilibrium capacity q^* is computed under the assumption that all $H \in [1, N-1]$ healthy insiders are willing to participate in the auction and bid for the PAs of all $N - H \in [1, N-1]$ failing firms. We derive the parametric conditions under which this assumption holds true at equilibrium. We focus on firm i at date 1/2 and suppose it is healthy. Two relevant cases where transfer of PAs may occur must be considered separately: either all $N - 1$ rivals fail or $H - 1 \in [1, N-2]$ rivals are healthy.

(i) Assume only firm i is healthy. In that case firm i is the only potential bidder and may buy PAs of up to $N - 1$ failing rivals. If firm i bids for PAs of $n \in [0, N-1]$ rivals its revenue is $P_{n+1}(n+1)\, q$, where $P_{n+1} = S - b(n+1)\, q$ indicates the demand function when PAs of $n + 1$ firms stay in the market and q denotes the symmetric capacity set by firms at date 0. The derivative of $P_{n+1}(n+1)\, q$ with respect to n is $q\,[S - 2bq(n+1)]$. This value is non-negative if and only if $q \leq \frac{S}{2b(n+1)}$. The RHS of this inequality is decreasing in n, hence it reaches its minimum value at $n = N - 1$ when it is $\frac{S}{2bN}$. It follows that condition

$$q \leq \frac{S}{2bN} \tag{B.1}$$

ensures that firm i's revenue $P_{n+1}(n+1)q$ is increasing in n, hence maximized at $n = N - 1$. In that case, firm i actually acquires all the PAs on sale, which is our assumption throughout the theoretical analysis, and the symmetric capacity set by firms at date 0 is q^*. Plugging capacity q^* into $(B.1)$ and rearranging yields

$$c \geq S \frac{(N-1)\left\{1 - p - (1-p)^N \left[1 + p(N-1)\right]\right\}}{2N(1-p)}. \tag{B.2}$$

(ii) Suppose now firm i plus $H - 1 \in [1, N-2]$ rivals are healthy. It follows that $H \in [2, N-1]$ firms may participate in the auction to buy PAs of up to $N - H \in [1, N-2]$ failing competitors. To make the main intuition easier to follow, we focus on $N = 4$ so that $H \in [2, 3]$.

When $H = 2$, two firms may participate in the auction to buy PAs of up to two rivals. Recalling that bids are simultaneous, the two firms play the following simultaneous symmetric game, where we omit the equilibrium capacity q to simplify the notation:

firm i bids for\healthy rival bids for	PAs of both rivals	PAs of one rival	No PAs
PAs of both rivals	$2P_4; 2P_4$	$\frac{5}{2}P_4; \frac{3}{2}P_4$	$3P_4; P_4$
PAs of one rival	$\frac{3}{2}P_4; \frac{5}{2}P_4$	$\frac{3}{2}P_3; \frac{3}{2}P_3$	$2P_3; P_3$
No PAs	$P_4; 3P_4$	$P_3; 2P_3$	$P_2; P_2$

(B.3)

The payoffs denote the firms' expected revenue. For instance, the payoffs in the first cell are computed as follows. If both firms play "PAs of both rivals", they are willing to pay the same reservation value $P_4q + P_4q$, derived from (1) with $N = 4$. Accordingly, there is a tie in the bids, in which case the ownership of the two PAs is randomly allocated to a single bidder. Omitting q, the expected payoff for firm i is thus: $3P_4$ when it wins the auction - this occurs with probability $\frac{1}{2}$ - because it obtains the PAs of both failing competitors; P_4 when it does not win the auction - this occurs with probability $\frac{1}{2}$: $\frac{1}{2}3P_4 + \frac{1}{2}P_4 = 2P_4$. Consider now the payoffs in the second cell, when firm i plays "PAs of both rivals" and the healthy rival plays "PAs of one rival". Firm i always obtains the PAs which the healthy rival is not bidding for, while getting the PAs of the second rival with probability $\frac{1}{2}$, since both players bid P_4q^* for them. Firm i gets $\frac{1}{2}3P_4 + \frac{1}{2}2P_4 = \frac{5}{2}P_4$. The other firm gets $\frac{1}{2}P_4 + \frac{1}{2}2P_4 = \frac{3}{2}P_4$. Similarly we compute all the other payoffs. It is easy to check that "PAs of both rivals" is a dominant strategy when condition $(B.2)$, mutatis mutandis, is fulfilled, i.e., when $P_{n+1}(n+1)$ is increasing in n. Therefore, in the unique NE, the two firms bid $P_4 2q^*$ in order to acquire the two PAs on sale.

When $H = 3$, three firms may participate in the auction to buy the PA of the only failing competitor. Again condition $(B.2)$ implies that the only NE is all the healthy, three, firms bidding for the single asset on sale. One can easily generalize the analysis to $N \in [2, \infty)$ by considering the following game:

firm i bids for\ $H - 1 \in [1, N-2]$ healthy rival bids for	PAs of $n \in [1, N-H]$ rivals	No PAs
PAs of $n \in [1, N-H]$ rivals	$\frac{1}{H}P_{H+n}(n+1)$ $+\left(1 - \frac{1}{H}\right)P_{H+n}$	$P_{H+n}(n+1)$
No PAs	P_{H+n}	P_H

(B.4)

Given symmetry of the payoffs, we write only firm i's payoff in each cell. If healthy rivals play "PAs of n rivals", the best response of firm i is to play "PAs of n rivals". If healthy rivals play "no PAs", the best response of firm i is to play "PAs of n rivals" if

$$P_{H+n+1}(n+2) \geq P_{H+n}(n+1) \text{ for any } n \in [0, N-H], \tag{B.5}$$

in which case the unique NE is all the healthy firms, H, bidding for the PAs of all failing rivals, $N-H$. Condition $(B.5)$ is equivalent to $\frac{n+2}{n+1} \geq \frac{P_{H+n}}{P_{H+n+1}}$. Note that $\frac{n+2}{n+1} > \frac{n+1+H}{n+H}$ given $H \in [2, N-1]$. Moreover, condition $(B.2)$ implies inequality $\frac{n+1+H}{n+H} \geq \frac{P_{n+H}}{P_{n+1+H}}$. We conclude that $(B.5)$ is implied by $(B.2)$. In that case the unique NE is all the healthy firms, bidding for the PAs of all failing rivals, which is our assumption throughout the theoretical analysis.

As a final step, we observe that the RHS of $(B.2)$ is monotonically increasing in $N \in [2, \infty)$ and it converges to $\frac{S}{2}$ when $N \to \infty$. Therefore $c \geq \frac{S}{2}$ implies $(B.2)$ for any admissible p and N. In other words, $c \in \left[\frac{S}{2}, S\right)$ is a sufficient condition for all healthy incumbents to be willing to bid for all the PAs on sale. Note that the value $c = 0.7$ in Figures 1, 2 and B.1 belongs to the interval $\left[\frac{S}{2}, S\right)$, when S is normalized to 1.

For the sake of completeness, we discuss briefly the opposite case where healthy firm i's revenue, $P_{n+1}(n+1)q$, decreases in $n \in [0, N-1]$. This occurs when derivative $q[S - 2bq(n+1)]$ is non-positive, i.e., if and only if $q \geq \frac{S}{2b(n+1)}$. The RHS of this inequality is decreasing in n, hence maximum at $n = 0$ and equal to $\frac{S}{2b}$. It follows that condition

$$q \geq \frac{S}{2b} \tag{B.6}$$

ensures that firm i's revenue $P_{n+1}(n+1)q$ is decreasing in n, hence maximized at $n = 0$, when no PAs are bought.

Two differences emerge compared with the case where $P_{n+1}(n+1)q$ is increasing in n. When only firm i is healthy at date 1, its maximum revenue is given by $P_1 q$, where $P_1 = S - bq$ denotes the demand function in case all the failing firms' PAs exit the market. Firm i is better-off not buying any of the PAs on sale. When, by contrast, $H \in [2, N-1]$ rivals are healthy, the multiple-bidder auction has a multiplicity of Nash equilibria, where each healthy firm bids for PAs of either all failing rivals, or all but one, or all but two, and so on up to no bid (the complete proof is available upon request).

Overall, if $(B.6)$ holds true the PAs' expected liquidation value is smaller and the equilibrium capacity set at date 0 is more likely to become monotonically decreasing in N.

B.3 Self-financed Firms

We show that q^* in Proposition 1 is the equilibrium capacity even when each firm i is self-financed, i.e., when its liquidity M is enough to finance the whole investment in capacity and the possible acquisition of failing rivals' PAs. To compute self-financed firm i's expected profit we proceed as follows. With probability p firm i actually competes in the product market by gaining $P_N q_i$. In addition, when firm i is the only bidder because $N-1$ rivals are failing - probability $p(1-p)^{N-1}$ - the equilibrium bid to acquire each rival is ε and firm i's extra-revenue is

$$p(1-p)^{N-1}[P_N(N-1)q^* - (N-1)\varepsilon]. \tag{B.7}$$

When instead there is at least a second bidder the equilibrium bid is equal to the reservation value in (1), hence firm i makes no extra-revenue. With probability $(1-p)$ firm i is in distress, in which case it cashes the liquidation value of its PAs:

$$(1-p)\left\{(N-1)\,p\,(1-p)^{N-2}\,\varepsilon+\left[1-(1-p)^{N-1}-(N-1)\,p\,(1-p)^{N-2}\right]P_N q_i\right\}. \tag{B.8}$$

This value is equivalent to the second term (in square brackets) of expression $(A.5)$. Taking into account $(B.7)$, $(B.8)$, and the investment cost cq_i, self-financed firm i's expected profit is equal to

$$\begin{aligned} U_i = p\left[P_N q_i + (1-p)^{N-1}\,P_N\,(N-1)\,q\right] + \\ (1-p)\left[1-(1-p)^{N-1}-(N-1)\,p\,(1-p)^{N-2}\right]P_N q_i - cq_i, \end{aligned} \tag{B.9}$$

At date 0 firm i chooses q_i to maximize $(B.9)$ for given equilibrium capacities q^* set by all other self-financed rivals. Note that $(B.9)$ is equivalent to (7). As a result, the symmetric equilibrium capacity when the firms are self-financed is as in Proposition 1.

C Additional table

In this section we report additional results of the empirical model.

Table C.1. here

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Table 1: Descriptive statistics: sample means by investment and debt status

	Not investing firms	Investing firms: No ML debt	Investing firms: With ML debt		Total
		L = 0	*0 < L* < 1	*L*=1	
Binary variables:					
Part of a group	15.1%	25.2%	20.3%	18.6%	20.4%
Less than 10 yrs	14.6%	9.4%	10.0%	12.4%	11.4%
Listed in stock market	1.0%	2.0%	1.2%	1.0%	1.4%
Part of an industrial district	13.6%	11.4%	11.4%	9.5%	11.7%
Only local competitors (*Ins* = 1)	29.7%	21.5%	18.6%	25.3%	23.7%
Herfindahl Index local product market (*H*)	0.0240	0.0244	0.0252	0.0205	0.0239
$Turnover_{2003}$ (Million euro)	12.7725	28.5506	30.1414	13.1305	22.3716
$Employees_{2003}$	48.4984	125.2241	135.0514	59.5072	96.9316
$(Fixed Assets/Turnover)_{2003}$	0.2061	0.2686	0.2551	0.2755	0.2494
$(Total debt/ Total assets)_{2003}$	0.6658	0.6270	0.6673	0.6826	0.6542
Return On Assets $(ROA)_{2003}$	0.0379	0.0466	0.0436	0.0389	0.0425
Herfindahl Index local credit market	0.1619	0.1680	0.1656	0.1594	0.1646
$(\Delta Shareholders funds/ Total assets)_{2003}$	-0.1228	-0.8332	-0.7285	0.0230	-0.4942
Percentage of investment financed with new ML bank debt (*L*,)	-	0	47.46%	100%	33.56%
Observations	947	1263	740	483	3433
(%)	27.6%	36.8%	21.6%	14.1%	100%

*Table 2: Percentage change of the probability to invest and resort to ML bank debt (columns 1-3) and of the share of investment funded by ML bank debt (columns 4 and 5). The effect of a variation of each variable is computed holding the value of the other variables constant at their sample mean; we consider discrete changes (from 0 to 1, 0→1 in the table) for the binary variables and a 1% change for the continuous covariates. Industry-province clustered standard errors in parentheses. Bootstrap standard errors in column (5). Effects computed on the entire sample of 3433 observations. *** p<0.01, ** p<0.05, * p<0.1*

	(1)	(2)	(3)	(4)	(5)
	$\Pr\left(A_{ijp}=1 \mid \mathbf{x}_{ijp}\right)$	$\Pr\left(D_{ijp}=1 \mid A_{ijp}=1, \mathbf{x}_{ijp}\right)$	$\Pr\left(A_{ijp}\times D_{ijp}=1 \mid \mathbf{x}_{ijp}\right)$	$E\left[L_{ijp} \mid A_{ijp}\times D_{ijp}=1, \mathbf{x}_{ijp}\right]$	$E\left[L_{ijp} \mid \mathbf{x}_{ijp}\right]$
Only local competitors	-10.3374***	-2.4744	-12.8118**	4.7423	-8.0695
(*Ins* 0→1)	(2.6218)	(5.3174)	(5.9242)	(2.8846)	(7.2877)
H_{ijp} (+1%)					
Effect when Ins_{ijp} = 0	-0.0110**	0.0049	-0.0061	-0.0011	-0.0072
	(0.0051)	(0.0111)	(0.0128)	(0.0051)	(0.0164)
Effect when Ins_{ijp} = 1	-0.0023	0.0331	0.0308	-0.0433***	-0.0125
	(0.0120)	(0.0223)	(0.0266)	(0.0137)	(0.0417)
Average effect	-0.0093*	0.0113	0.0020	-0.0119**	-0.0099
	(0.0050)	(0.0102)	(0.0120)	(0.0051)	(0.0159)
Part of a group (0→1)	1.5740	-19.1110***	-17.5370**	4.8374	-12.6996
	(2.8984)	(6.0856)	(6.8592)	(3.4966)	(9.1310)
Less than 10 yrs (0→1)	-6.3094*	3.9936	-2.3158	3.4538	1.1380
	(3.5699)	(6.3985)	(7.3039)	(3.7336)	(9.3611)
Listed (0 → 1)	-5.8991	-16.2060	-22.1051	0.14925	-21.9558
	(11.4645)	(20.3010)	(24.6849)	(16.1355)	(33.8033)
Part of an industrial district	0.8499	1.2880	2.1379	-0.6594	1.4784
(0→1)	(4.0832)	(7.4568)	(8.4419)	(3.8872)	(10.5073)
$Turnover_{2003}$ (+1%)	0.0131	-0.0224	-0.0093	-0.0404***	-0.0497
	(0.0127)	(0.0260)	(0.0293)	(0.0136)	(0.0347)
$Employees_{2003}$ (+1%)	0.1070***	0.0706**	0.1776***	-0.0429***	0.13473***
	(0.0172)	(0.0284)	(0.0338)	(0.0159)	(0.0456)
$(Fixed Assets/Turnover)_{2003}$	0.0415***	0.0180	0.0595***		0.0595***
(+1%)	(0.0094)	(0.0121)	(0.0160)		(0.0194)
$(Total debt/ Total assets)_{2003}$	0.0842**	0.4434***	0.5276***	0.0421	0.5697***
(+1%)	(0.0414)	(0.0762)	(0.0890)	(0.0487)	(0.1587)
$(ROA)_{2003}$ (+1%)	0.0247***	0.0114	0.03610***	-0.0084	0.0277*
	(0.0063)	(0.0122)	(0.0133)	(0.0085)	(0.0163)
Herfindahl Index local credit market (+1%)	0.0231	-0.0805**	-0.0575	-0.0510*	-0.1084*
	(0.0235)	(0.0396)	(0.0449)	(0.0274)	(0.0591)
(ΔShareholders funds/ Total	0.0006*	-0.0001	0.0004	-0.0005***	-0.0001
$assets)_{2003}$ (+1%)	(0.0003)	(0.0006)	(0.0008)	(0.0001)	(0.28852)

*Table 3: Robustness checks: percentage change of the probability to invest and resort to ML bank debt (columns 1-3) and of the share of investment funded by ML bank debt (column 4). The effect of a variation of each variable is computed holding the value of the other variables constant at their sample mean; we consider discrete changes (from 0 to 1, 0→1 in the table) for the binary variables and a 1% change for the continuous covariates. Industry-province clustered standard errors in parentheses. Effects computed on the entire sample of 3433 observations. *** p<0.01, ** p<0.05, * p<0.1*

	(1)	(2)	(3)	(4)
	$\Pr\left(A_{ijp}=1 \mid \mathbf{x}_{ijp}\right)$	$\Pr\left(D_{ijp}=1 \mid A_{ijp}=1,\mathbf{x}_{ijp}\right)$	$\Pr\left(A_{ijp}\times D_{ijp}=1 \mid \mathbf{x}_{ijp}\right)$	$E\left[L_{ijp} \mid A_{ijp}\times D_{ijp}=1,\mathbf{x}_{ijp}\right]$
Dealing with measurement error in H: using dummies based on H quartiles				
Ins (0 → 1)	-10.2963***	-3.1577	-13.4540**	4.1499
	(2.6596)	(5.3049)	(5.9506)	(3.0066)
H 25 – 49 percentile (0 → 1)				
Effect when *Ins* = 0	4.1031	-3.1691	0.9340	-5.8746
	(3.1313)	(6.8007)	(7.1584)	(4.0342)
Effect when *Ins* = 1	-7.3552	-2.0433	-9.3985	1.5512
	(6.6472)	(11.8291)	(12.9766)	(6.8016)
Average effect	2.0263	-2.7458	-0.7195	-3.9101
	(3.0081)	(6.0399)	(6.3286)	(3.4130)
H 50 – 74 percentile (0 → 1)				
Effect when *Ins* = 0	0.5820	5.4646	6.0467	-1.5306
	(3.1303)	(7.3932)	(7.9738)	(3.5589)
Effect when *Ins* = 1	1.6962	-10.8166	-9.1204	1.7509
	(6.7577)	(13.0089)	(14.3301)	(5.9554)
Average effect	0.8135	1.6946	2.5081	-0.6798
	(3.0732)	(6.6843)	(7.3113)	(3.0138)
H 75 – 100 percentile (0 → 1)				
Effect when *Ins* = 0	-1.6189	4.3538	02.7349	-3.3393
	(3.8085)	(7.5889)	(08.4960)	(3.4714)
Effect when *Ins* = 1	1.8626	-15.8628	-14.0002	-15.4125*
	(7.2355)	(14.8819)	(16.1416)	(8.9291)
Average effect	-0.8931	-0.2850	-1.1781	-6.1451*
	(3.5944)	(7.1387)	(7.9703)	(3.3295)
Herfindahl index H based on turnover				
Ins (0 → 1)	-10.5791***	-2.4904	-13.0696**	4.0472
	(2.6259)	(5.3375)	(5.9619)	(2.9665)
H (+1%)				
Effect when *Ins* = 0	-0.0122	-0.0110	-0.0232	-0.0103
	(0.0089)	(0.0185)	(0.0210)	(0.0091)
Effect when *Ins* = 1	-0.0183	0.0204	0.0021	-0.0804***
	(0.0208)	(0.0419)	(0.0494)	(0.0289)
Average effect	-0.0135	-0.0037	-0.0172	-0.0279***
	(0.008886)	(0.0175)	(0.0201)	(0.0097)
Measuring PMC as the number of operating firms (N)				
Ins (0 → 1)	-10.3652***	-2.8251	-13.1903**	4.7347
	(2.6259)	(5.2973)	(5.9278)	(2.9116)
N (+1%)				
Effect when *Ins* = 0	0.0050	-0.0067	-0.0017	0.0022
	(0.0090)	(0.0184)	(0.0208)	(0.0096)
Effect when *Ins* = 1	-0.0097	0.0248	0.0151	0.0483**
	(0.0179)	(0.0359)	(0.0399)	(0.0218)
Average effect	0.0021	0.0007	0.0029	0.0139
	(0.0089)	(0.0169)	(0.0191)	(0.0088)

*Table 3 (cont.): Robustness checks: percentage change of the probability to invest and resort to ML bank debt (columns 1-3) and of the share of investment funded by ML bank debt (column 4). The effect of a variation of each variable is computed holding the value of the other variables constant at their sample mean; we consider discrete changes (from 0 to 1, 0→1 in the table) for the binary variables and a 1% change for the continuous covariates. Industry-province clustered standard errors in parentheses. Effects computed on the entire sample of 3433 observations. *** p<0.01, ** p<0.05, * p<0.1*

	(1)	(2)	(3)	(4)
	$\Pr\left(A_{ijp}=1 \mid \mathbf{x}_{ijp}\right)$	$\Pr\left(D_{ijp}=1 \mid A_{ijp}=1,\mathbf{x}_{ijp}\right)$	$\Pr\left(A_{ijp}\times D_{ijp}=1 \mid \mathbf{x}_{ijp}\right)$	$E\left[L_{ijp} \mid A_{ijp}\times D_{ijp}=1,\mathbf{x}_{ijp}\right]$
Profitability and PMC: controlling for the average ROE of the local product market				
Ins (0 → 1)	-10.5657***	-2.5215	-13.0873**	5.0517*
	(2.6329)	(5.3331)	(5.9231)	(2.8265)
ROE (+1%)				
Effect when *Ins* = 0	0.0002	0.0273	0.0275	-0.0081
	(0.0118)	(0.0259)	(0.0283)	(0.0117)
Effect when *Ins* = 1	-0.0637**	-0.0192	-0.0829	0.0315
	(0.0307)	(0.0543)	(0.0632)	(0.0333)
Average effect	-0.0124	0.0171	0.0047	0.0020
	(0.0115)	(0.0238)	(0.0262)	(0.0107)
H (+1%)				
Effect when *Ins* = 0	-0.0110**	0.0053	-0.0057	-0.0010
	(0.0051)	(0.0112)	(0.0129)	(0.0052)
Effect when *Ins* = 1	-0.0010	0.0342	0.0332	-0.0404***
	(0.0123)	(0.0223)	(0.0264)	(0.0114)
Average effect	-0.0092*	0.0119	0.0027	-0.0111**
	(0.0050)	(0.0102)	(0.0120)	(0.0049)
An alternative indicator for the presence of outsiders: Ins=1 when all the rivals of the company are in the same province of the company itself, and zero otherwise				
Ins (0 → 1)	-5.8224	-15.2745*	-21.0969**	4.5219
	(4.2519)	(9.1641)	(9.5842)	(4.5440)
H (+1%)				
Effect when *Ins* = 0	-0.0092*	0.005968	-0.0032	-0.0046
	(0.0050)	(0.0104)	(0.0120)	(0.0045)
Effect when *Ins* = 1	-0.0156	0.1128**	0.0973*	-0.0924***
	(0.0161)	(0.0496)	(0.0548)	(0.0193)
Average effect	-0.0096*	0.0136	0.004	-0.0123***
	(0.0049)	(0.0103)	(0.0120)	(0.0045)
Subsidized debt included in the definition of new ML bank debt				
Ins (0 → 1)	-10.4198***	-5.4813	-15.9011***	4.2762*
	(2.6175)	(4.5736)	(5.4118)	(2.4253)
H (+1%)				
Effect when *Ins* = 0	-0.0108**	0.0045	-0.0062	-0.0030
	(0.0052)	(0.0097)	(0.011)	(0.0049)
Effect when *Ins* = 1	-0.0022	0.0160	0.0139	-0.0292*
	(0.0120)	(0.0193)	(0.0238)	(0.0152)
Average effect	-0.0091*	0.0069	-0.0022	-0.0098*
	(0.0050)	(0.0090)	(0.0107)	(0.0054)

*Table C1: Pseudo maximum likelihood estimates. Industry-province clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

	(1) $E\left[\tilde{a}_{ijp} \mid \mathbf{x}_{ijp}\right]$	(2) $E\left[\tilde{d}_{ijp} \mid \mathbf{x}_{ijp}\right]$	(3) $E\left[\ln \tilde{L}_{ijp} \mid A_{ijp} \times D_{ijp} = 1, \mathbf{x}_{ijp}\right]$
Part of a group	0.0365	-0.2212***	0.1078
	(0.0679)	(0.0665)	(0.0806)
Less than 10 yrs	-0.1365*	0.0788	0.0768
	(0.0729)	(0.0814)	(0.0853)
Listed in the stock market	-0.1265	-0.1474	0.0032
	(0.2306)	(0.2088)	(0.3509)
Part of an industrial district	0.0196	0.0109	-0.0142
	(0.0951)	(0.0914)	(0.0835)
Only local competitors (Ins_{ijp} = 1)	-0.2444***	-0.0052	0.2038***
	(0.0552)	(0.0777)	(0.0708)
Herfindahl Index local product market (H_{jp})	-1.1159**	0.4841	-0.1008
	(0.5160)	(0.5593)	(0.4552)
$(Ins_{ijp}=1) \times H_{jp}$	0.9342	1.1474	-4.1191***
	(1.0360)	(1.2044)	(1.3718)
Ln(Turnover)$_{2003}$	0.030	-0.0330	-0.0876***
	(0.0291)	(0.0306)	(0.0297)
Ln(Employees)$_{2003}$	0.2450***	0.0286	-0.0930***
	(0.0394)	(0.0543)	(0.0350)
Ln(Fixed Assets/Turnover)$_{2003}$	0.0951***		
	(0.0215)		
(Total debt/ Total assets)$_{2003}$	0.2947**	0.7314***	0.1395
	(0.1449)	(0.1578)	(0.1614)
(ROA)$_{2003}$	1.3294***	0.0213	-0.4269
	(0.3383)	(0.3701)	(0.4352)
Herfindahl Index local credit market	0.3210	-0.6463**	-0.6717*
	(0.3277)	(0.2965)	(0.3624)
(ΔShareholder funds/ Total assets)$_{2003}$	-0.0026*	0.0008	0.0024***
	(0.0015)	(0.0011)	(0.0005)
Constant	-0.2082	-0.2814	4.8401***
	(0.1901)	(0.3490)	(0.1797)
ρ	-0.5050		
	(0.3703)		
σ			0.8451***
			(0.0307)
Observations	3,433	3,433	1,223

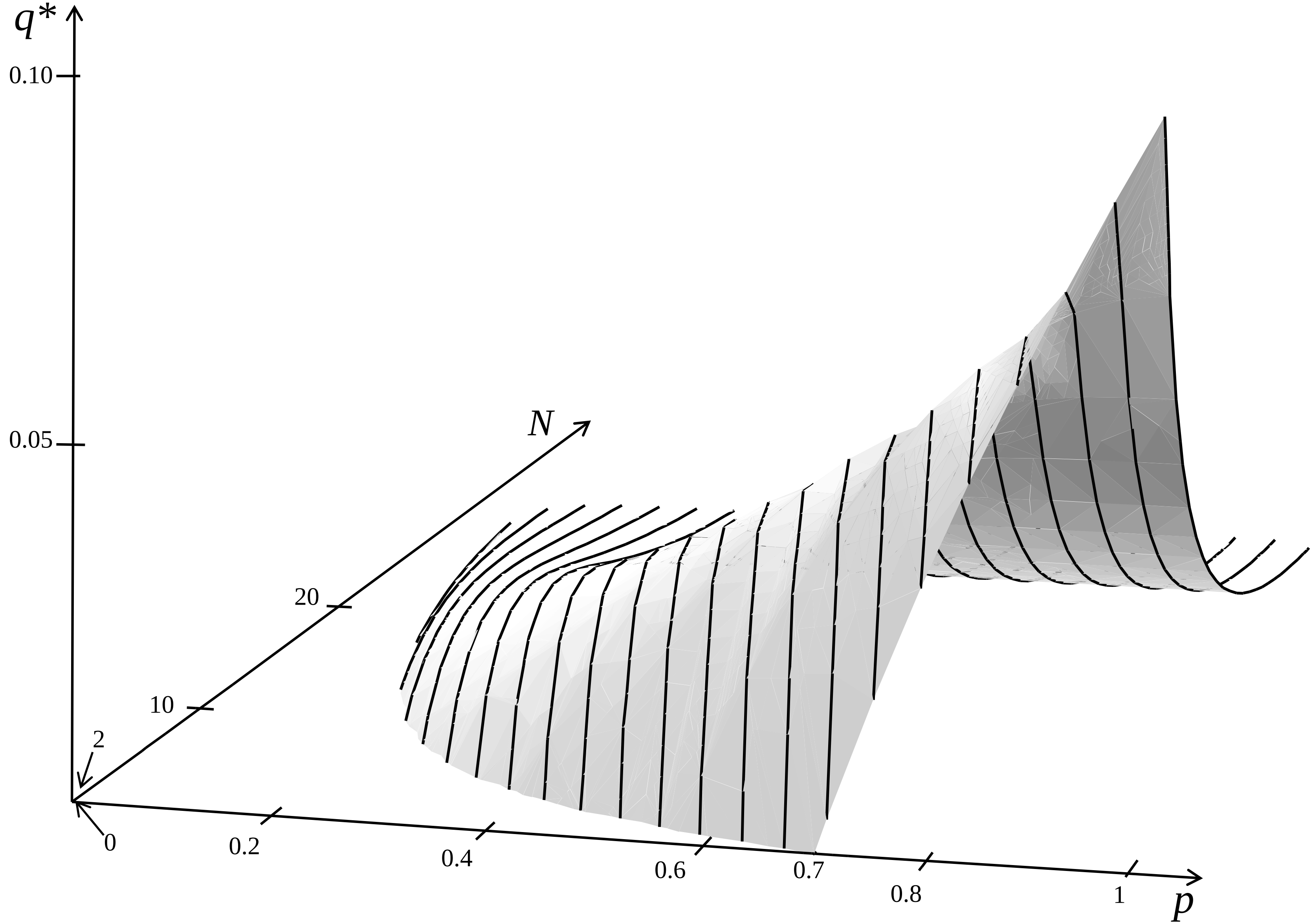

Figure 1: The diagram shows the equilibrium capacity *q** as a function of the success probability *p* and the number of active firms at date 0, N. The other parameters are set at values *S=b=1* and *c=0.7*.

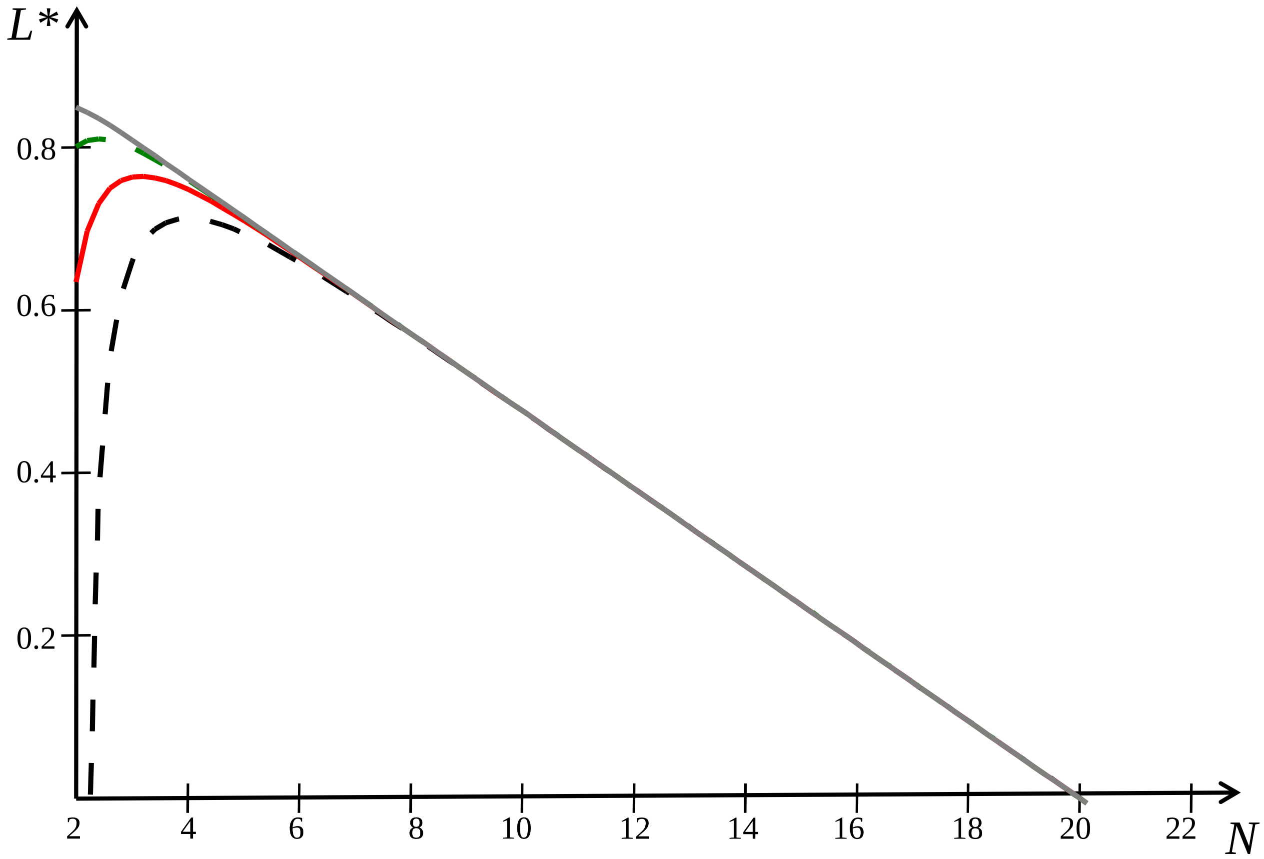

Figure 2: The diagram shows the equilibrium percentage of investment financed with debt *L** as a function of the number of active firms at date 0, *N*. The other parameters are set at values *S=b=1*, *c=0.7*, and *M=.01*. From the upper line the probability of success *p* is set at 0.98 (upper solid line), and then in descending order at 0.9 (upper dashed line), 0.8 (lower solid line) and 0.7 (lower dashed line).

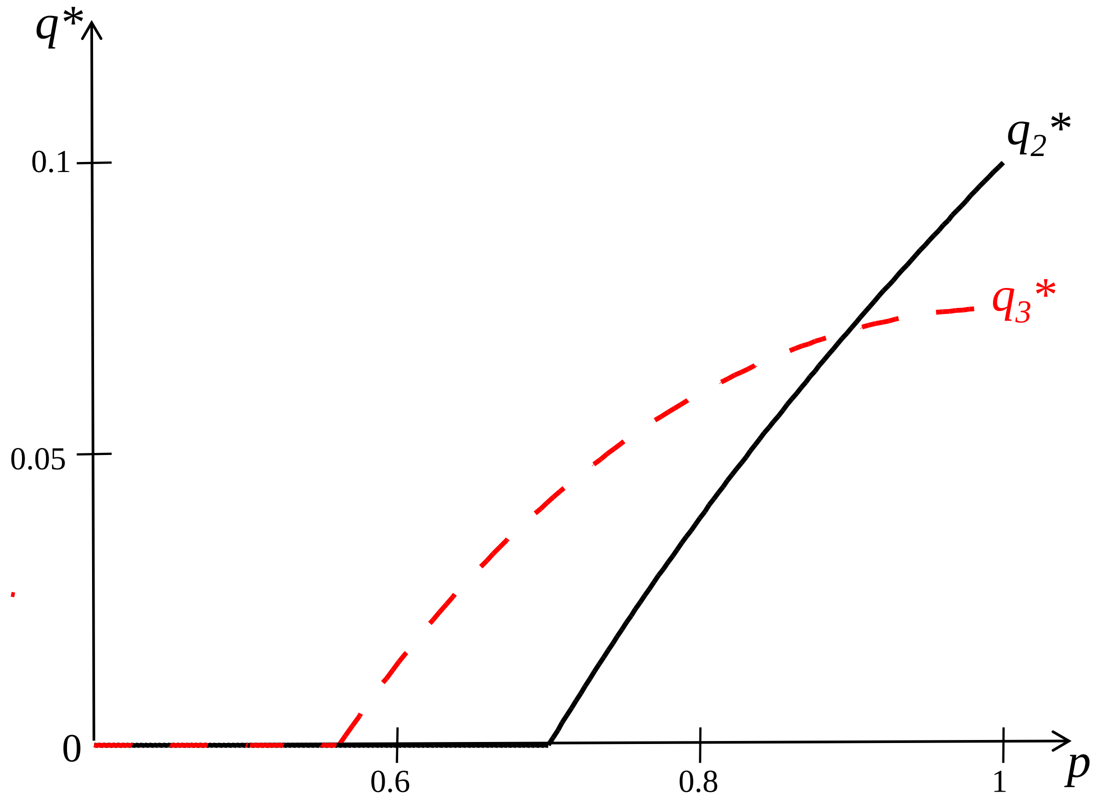

Figure B.1: The diagram shows the equilibrium capacity q^* as a function of the success probability p for different numbers of active firms at date 0, $N=3$ (dashed line) and $N=2$ (solid line). The other parameters are set at values $S=b=1$ and $c=0.7$.