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

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

This draft: September 29, 2013

Abstract

We present a model where the level of collateralized credit available to borrowers depends upon their product market structure. We find that a larger number of competitors in a Cournot industry with positive probability of bankruptcy may increase credit availability by enhancing the expected resale value of the collateralized productive assets. We also show this benefit of competition is negatively affected by the existence of outsiders willing to bid for the insiders' productive assets. We test our theoretical predictions exploiting information on the access to finance of small and medium Italian firms in the period 2004-2006 and find supportive evidence.

JEL classification: D22 (Firm Behavior: Empirical Analysis); L13 (Oligopoly); G33 (Liquidation).

Keywords: collateralized loans; product market competition; productive assets resale value.

*A previous draft of this paper has been circulated under the title "Product market competition and collateralized debt". We appreciated comments from participants in the Conference "Liquidity, Banking and Financial Markets", Bologna University, Bologna (June 2012), in the 39th Annual Conference of the European Association for Research in Industrial Economics (EARIE 2012), Luiss University, Rome (September 2012), in the 28th Annual Meetings of the European Economic Association (EEA 2013), Gothenburg, Sweden (August 2013) and especially from our discussant Joao Montez.

[a]Corresponding author: Milano-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; fax: +39-02-6448-5878.

[b]Free University of Bozen/Bolzano, School 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: miniaci@eco.unibs.it.

1 Introduction

External finance is a vital ingredient for firms willing to undertake productive investments. The cost of external finance however varies across countries and industries and dampens firms' growth especially for what concerns small and medium enterprises (SMEs) as shown by Rajan and Zingales (1998). Policy makers seeking solutions to curtail credit rationing, have considered so far ways to reduce opaqueness of SMEs or to improve bank long-term relationship (see Berger and Udell, 1995). We explore a different channel: we suggest that increasing competition in the product market or, alternatively, opening the access to second-hand markets of productive assets to outside bidders might improve SMEs' ability to raise external funding.

The aim of this paper is to understand how external finance is affected by the structure of the product market in which firms compete. The amount of firms' external finance available to undertake new investments depends upon the pledgeable income to creditors as extensively illustrated by Holmstrom and Tirole (1997). Greater competition in the product market, by shrinking profits, reduces the amount that can be pledged to creditors and hence it is not beneficial.

However firms may boost further their borrowing capacity 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. In this context, the resale value of PAs plays a crucial role, as proved by evidence in Almeida and Campello (2007), Ortiz-Molina and Phillips (2009) and Benmelech and Bergman (2009). One of the most important determinants of such a value is the existence of competitors in the product market willing to acquire the PAs in order to reuse them in the production.

However, not only the competitors' mere existence but also their financial strength is crucial. Shleifer and Vishny (1992) were the first to notice that the state of health of rivals in the same industry might affect the resale value of productive equipments. Support to this can be found in the evidence provided by Acharya et al. (2007) who measure how industry characteristics affect recovery rates of PAs.

In this paper we propose a theoretical framework to study the relation between collateralized lending and the structure of the product market and we test the main predictions of the model on a sample of Italian SMEs. In the model firms competing à la Cournot in their product market apply for loans from lenders in order to undertake productive projects and post their PAs as collateral in the loan. Each productive project is risky since it may fail with a positive probability, in which case lenders will not be repaid. Default probabilities are independent across firms. Lenders after extending the loan, might learn that the project will fail; in this case the lender seizes the collateralized PAs and liquidates them before production takes place. The PAs are traded in an auction where successful rivals and outside firms are the potential buyers. Given that several PAs may be liquidated when idiosyncratic shocks hit several projects at the same time, the resale value of the PAs depends upon the number of bidders and the number of assets on sale in the second-hand market. We show that the equilibrium quantities in the competition stage depart from the standard Cournot equilibrium due to the non-zero probability of default, while encompassing it when such a probability is zero.

Our main finding is that the amount of credit, and therefore the equilibrium quantity, might be increasing in the number of rivals: this effect fades away as the number of rivals becomes relatively large. The intuition rests on the existence of the following trade-off. On the one hand, as the initial number of rivals rises, there is an increasing number of states in which firms may be healthy and can bid for the PAs: this increases the expected recovery value of PAs and enhances the pledgeable income to lenders. On the other hand, profits fall with competition, thus shrinking in equilibrium the amount of credit. The positive effect is shown to outdo the negative effect for an increasing although relatively small number of firms in the same market.

This effect captures the idea of an increasing liquidity of productive assets used as collateral in the debt contract. In the model we show that the existence of rivals outside the industry interested in acquiring the productive asset reduces this effect of internal product market competition by enhancing the resale value of PAs.

In the second part of the paper we test the main predictions of the model on a sample of Italian SMEs. We use a survey on access to finance where a sample of Italian SMEs are asked about the way they finance their productive investments. We apply a probit model with sample selection to test the amount of bank debt conditional on the decision to invest and find evidence that greater product market competition, measured as a low Herfindahl index in the sector where the firm operates, increases the amount of bank credit to SMEs. We also find that the positive effect of greater product market competition on credit availability is smaller in industries with outside rivals.

The results in the paper have important implications for the availability of external finance to SMEs. In phases where bank credit shrinks, due for instance to a credit crunch, it might be important to know alternative ways to improve access to finance. We suggest that policies aiming at promoting competition in the product market or alternatively at simplifying the access to second-hand market of PAs for outside bidders have the desiderable effect of increasing credit availability for SMEs.

Related literature. This paper is closely related to Shleifer and Vishny (1992) for the idea that the firms' 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 greatest, that is when direct rivals are in the position to bid for the assets.[1] Our paper adds the consideration that the competitive environment of the product market is relevant to determine both the level of profitability and the recovery value of PAs. Almeida et al. (2009) develop a model with independent liquidity shocks, similar to the one in this paper, in order to study the availability of credit lines for firms with industry-specific PAs, however they ignore product market competition.

In the literature that relates credit availability to product market competition (see, *e.g.*, Brander and Lewis, 1986), the focus is on the impact of external finance on competitive behavior of firms in the product market. The novelty in our paper is to explore the reverse causality, that is the impact of product market competition on external finance. We are not aware of other papers where this feedback is explored, except Cerasi and Fedele (2011): we depart from our first contribution where we studied a model with moral hazard between creditors and entrepreneurs in a duopoly setting, by extending the analysis to the case in which a

[1] Empirical support to this prediction is provided by Habib and Johnsen (1999), Ortiz-Molina and Phillips (2009) and Gavazza (2010).

large number of firms compete in the product market with perfect symmetric information.

The remainder of the paper is organized as follows. Section 2 describes the setup of the model. In Section 3 we derive the main equilibrium results. The equilibrium properties are studied in Section 4. The empirical analysis is presented in Section 5, while Section 6 concludes the paper.

2 The Economy

Consider $N \geq 2$ incumbent firms competing à la Cournot for the sale of a homogeneous good. At date 0 each firm $i = \{1, ..., N\}$ invests I_i to undertake a risky productive project. At date 1 the project returns a positive cash flow $P_N \times q_i$ with probability $p \in (0, 1]$ or 0 otherwise, where: $P_N = S - b \sum_{i=1}^{N} q_i$ is the inverse demand function, S denotes the consumers' maximum willingness to pay, q_i the quantity of the good supplied by firm i, and b measures how the price P_N is affected by changes in total output $\sum_{i=1}^{N} q_i$. Probabilities of success p are identical and independent across firms. The initial investment I_i indicates the expenditure borne by firm i to acquire the PAs necessary to supply q_i. The functional relationship between I_i and q_i is as follows

$$I_i = cq_i, \tag{1}$$

where cq_i, $c \in (0, S)$, denotes the total production cost.

Firm i owns limited funds $M < I_i$. The residual amount $I_i - M$ is borrowed from a competitive banking sector at date 0. The loan agreement consists in a collateralized debt contract $\{r_i\}$, where parameter $r_i > 0$ denotes the repayment to the bank by firm i at date 1. Firm i is not able to repay the debt with probability $1 - p$, in which case it defaults.

Banks are informed creditors in that at an interim date 1/2 they receive a perfect signal about the future realization of the project cash flow.[2] If the signal is negative - this occurs with probability $1 - p$ - the banks anticipate that the borrower will not be able to repay the debt, they seize the failing firm's PAs, sell them in the second-hand market and cash the liquidation value.[3] The PAs are traded at an auction. In Section 3 the healthy incumbent competitors are supposed to be the sole potential bidders. Subsection 3.3 extends the analysis to the case where also outside firms can acquire the PAs with the aim of entering the market.

Before proceeding, we specify the timing of events.

- At date 0 each firm i invests own funds M and borrows $I_i - M$ from a competitive banking sector to undertake a productive project. Afterwards, each firm i sets the Cournot quantity q_i.
- At interim date 1/2 the banks receive a perfect signal about the future realization of project's cash flow. In case of a negative signal the banks seize the PAs, which are then auctioned off.

[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-lenght" creditors. 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 from a defaulted firm to a successful one, their value can be restored. This is to be interpreted as a shock related to human rather than to physical capital, in line with Cerasi and Fedele (2011).

- At date 1 healthy (successful) firms and potential outsiders compete in the product market using the PAs resulting from the relocation of ownership at date 1/2.

3 Cournot Equilibrium

In this section we solve backwards the model laid out above. We first study the auction for the failing firms' PAs, which occurs at date 1/2 among the healthy firms. We then compute the Cournot equilibrium quantity, selected by the firms at date 0.[4]

At date 1/2 the healthy firms decide first whether to participate in the auction and then how much to bid. Bids are simultaneous. We assume that any firm i is willing to participate in the auction and bid for all the available PAs. Lemma 2 in Subsection 3.2 computes the parametric conditions under which our claim on the firms' behavior holds true at equilibrium.

On the above basis, we calculate the equilibrium bids for the failing firms' PAs. Three alternative scenarios must be investigated separately.

(i) Obviously, if all firms or none of them is healthy there is no transfer of assets and the equilibrium bid is zero.

(ii) By contrast, when at least two firms are healthy at date 1/2, we rely on a Bertrand argument to state that the equilibrium bid coincides with the firms' reservation value, *i.e.*, the maximum amount of money they are willing to bid for all the distressed competitors' PAs.[5] To get such a value, assume that firm i plus $H \geq 1$ rivals are healthy, so that $H + 1 \geq 2$ firms participate in the auction. Firm i's reservation value for PAs of the $N - 1 - H$ failing competitors amounts to

$$P_N \left(N - H \right) q^* - P_N \times q^* = P_N \left(N - H - 1 \right) q^*. \tag{2}$$

Expression q^* denotes the symmetric N-oligopoly Cournot equilibrium quantity, which has already been set at date 0. The first term in (2) is firm i's revenue after the acquisition of all the available PAs, where $P_N \equiv S - b \times N\overline{q}$ indicates the demand function. The second term denotes the revenue of firm i when it decides not to buy the PAs.[6] In such a case, the PAs are bought by a rival firm, hence the industry quantity is still Nq^* and the price is P_N. In case of tie in the bids, the ownership of the (indivisible) PAs is randomly allocated to a single bidder.[7]

(iii) Finally, when only firm i is healthy at date 1/2 the equilibrium bid is supposed to equal ε, with ε positive but small.

[4] It is worth anticipating that although N symmetric firms are initially active in the industry at date 0, the structure of the product market at date 1 might be asymmetric for firms of different sizes may cohexist. As a matter of fact, such an ex-post structure is determined through the realized transfers of ownership of the failed rivals' PAs among healthy firms.

[5] Note that firms are credit constrained, hence it is their banks that grant additional funds to enable them to participate in the auction.

[6] Note that we disregard production costs cq^* when writing (2) since such costs are sunk, *i.e.*, they are borne by any firm i at date 0.

[7] This is (mathematically) equivalent to assume that PAs are instead divisible and that their ownership is uniformly shared among all bidders.

To make the main intuition easier to follow, we introduce the Cournot equilibrium analysis in the special case of three incumbents at date 0. The general analysis with $N \geq 2$ firms is postponed to Subsection 3.2.

3.1 Cournot Competition with $N = 3$ Firms

In this subsection we let $N = 3$ and we select firm 1 as the representative firm. To compute its expected profit at date 0, denoted by U_1, we anticipate that at the symmetric Cournot equilibrium all firms but 1, *i.e.*, firms 2 and 3, choose the same quantity $\overline{q}$.

Firm 1 solves the following problem: it maximizes U_1 subject to its bank's participation constraint. Full bargaining power in the hands of the firm is justified by the fact that the bank is competitive. As a result U_1 boils down to the expected surplus of the project implemented by firm 1,[8]

$$U_1 = p\left[P_3 q_1 + (1-p)^2 P_3 2\overline{q}\right] + (1-p)\, p^2 P_3 q_1 - c q_1, \tag{3}$$

where q_1 denotes the quantity produced by firm 1.

Expression (3) can be read as follows. With probability p firm 1 is successful and earns at least $P_3 q_1$. It gains an extra revenue $P_3 2\overline{q}$ when, by being healthy, participates in a single-bidder auction and acquires both rivals' PAs at a negligible unit price ε - this occurs with probability $p(1-p)^2$. In all other cases where firm 1 succeeds, its extra gain is zero since no trade of PAs takes place; or the equilibrium bid coincides with the firm's reservation value; or, finally, firm 1 does not win the auction. By contrast, with probability $(1-p)p^2$ firm 1 fails but the two rivals are healthy. Their equilibrium bid for firm 1's PAs is $P_3 q_1$,which is obtained by (2) after plugging $N = 3$, $H = 1$ and q_1 instead of q^*. In all other circumstances where firm 1 fails, its extra gain is zero because either no trade of PAs takes place - with probability $(1-p)^3$ - or its PAs are sold at a negligible price ε - with probability $2(1-p)^2 p$. The last term of (3) is the cost of producing the quantity q_1.

To compute the Cournot equilibrium quantity selected by firm 1 at date 0 we take the derivative of (3) with respect to q_1 for given quantities set by rivals at the equilibrium level $\overline{q}$. In the symmetric equilibrium all quantities are equal to

$$\overline{q} = \frac{\left[p + (1-p)\, p^2\right] S - c}{2bp\,(3 - p^2)}. \tag{4}$$

3.2 Cournot Competition with $N \geq 2$ Firms

In this subsection we generalize the analysis by studying the Cournot equilibrium when $N \geq 2$ incumbent firms are present at date 0. The reasoning is as in Subsection 3.1. Firm i maximizes its expected profit, denoted by U_i, given that its bank breaks-even. We get[9]

$$U_i = p\left[P_N q_i + p\,(1-p)^{N-1} P_N\,(N-1)\, q^*\right] + (1-p) \sum_{H=2}^{N-1} \binom{N-1}{H} p^H (1-p)^{N-1-H} P_N q_i - c q_i, \tag{5}$$

where q_i is the quantity produced by firm i. Recall that q^* denotes the symmetric N-oligopoly Cournot equilibrium quantity and that H $(N-1-H)$ is the number of $N-1$ rival firms whose banks receive a positive (negative) signal about the projects' realization at the interim date 1/2.

[8] See Appendix A.1 for computations and further details.

[9] See Appendix A.2 for computations and further details.

Formula (5) is to be interpreted similarly to (3). With probability p firm i is successful and earns at least $P_N q_i$. The extra revenue $P_N(N-1)q^*$ accrues when, by being healthy, firm 1 participates in a single-bidder auction and acquires both rivals' PAs at a negligible unit price ε - this occurs with probability $p(1-p)^{N-1}$. Finally, when firm i fails but at least two rivals are healthy, firm i gains $P_N q_i$, which is the equilibrium bid for its PAs. This last scenario occurs with a probability given by the binomial function when there are $H \geq 2$ bidders among $N-1$ firms. The last term of (3) is the cost of producing the quantity q_i.

Taking the derivative of (5) with respect to q_i for given quantities set by rivals at the equilibrium level q^* yields the symmetric Cournot equilibrium quantity in a N-oligopoly, which we report in the following

Lemma 1 *When only incumbent firms participate in the auction for productive assets, the symmetric equilibrium quantity in the Cournot game with N firms is*

$$q^* = \frac{S\left\{1-(1-p)^{N-1}\left[1+p(N-2)\right]\right\}-c}{b\left\{(N+1)-(1-p)^{N-1}\left[N+1+p(N-1)^2-2p\right]\right\}}. \tag{6}$$

Formula (6) denotes the equilibrium quantity in a Cournot game where each firm faces an independent idiosyncratic probability of failure and PAs are collateralized. As a matter of fact, this amount collapses to the standard Cournot equilibrium quantity with linear production costs cq when $p=1$, $\frac{S-c}{b(N+1)}$. This implies that the possibility of trading PAs affects the quantity chosen at the equilibrium. The channel is the banks' expectation of what can be recovered from the sale of the PAs. As we will see in Section 4, this is the crucial mechanism at work in our model which, for some constellations of parameters, might reverse the standard negative effect of a declining equilibrium quantity as the number of firms in the Cournot industry increases.

As mentioned at the beginning of Section 3 the Cournot equilibrium quantity q^* is computed under the assumption that any firm i is willing to participate in the auction and bid for all the available PAs. Before proceeding we thus write the following

Lemma 2 $c \in \left[\frac{S}{2}, S\right)$ *is a sufficient condition for any firm i to be willing to participate in the auction and bid for all the available PAs.*

Proof. See Appendix A.3. ■

Inequality $c \geq \frac{S}{2}$ implies

$$\frac{Nq^*}{(N-1)q^*} \geq \frac{(P_{N-1}=)\,S-b\times(N-1)q^*}{(P_N=)\,S-b\times Nq^*}. \tag{7a}$$

The comparison between the two terms in ($7a$) represents the standard Cournot trade-off. If a firm produces more, Nq^* instead of $(N-1)q^*$, it is able to sell more, $\frac{Nq^*}{(N-1)q^*}>1$, but it affects the market price negatively, $\frac{P_{N-1}}{P_N} = \frac{S-b\times(N-1)q^*}{S-b\times Nq^*} > 1$. When c is high relatively to S then q^* is low, as one can check by inspecting Lemma 1. In turn, if $q^* \to 0$, inequality ($7a$) is fulfilled as the RHS tends to 1. Indeed $\frac{N}{N-1}$, the positive effect of increasing the production, is not affected by q^*. By contrast $\frac{S-b\times(N-1)q^*}{S-b\times Nq^*}$, the negative effect of increasing the production, is affected by q^*: the lower q^*, the lower such negative effect in that the price is poorly sensitive to a production increase.

3.3 Entry through Acquisition

In this subsection we relax the assumption that only incumbent firms can acquire the PAs of failing rivals. We suppose that at date 1/2 at least two homogeneous outsiders compete with the insiders in the auction for second-hand PAs. The outsiders stand a fixed entry cost E to be able to operate in the industry. Their reservation value for a failing incumbent firm's PAs amounts to

$$P_N\hat{q} - E - 0, \tag{8}$$

which we assume to be higher than zero. Parameter $\hat{q}$ denotes the symmetric Cournot equilibrium quantity when also the outsiders are taken into account, already selected by the incumbent firms at date 0. Expression $P_N\hat{q} - E$ represents an outsider's revenue when entering the market after buying a failing firm's PAs and bearing the entry cost E, whilst zero is assumed to be its revenue in case it stays out of the market.

We compute the Cournot equilibrium in the following

Lemma 3 *When at least two outsiders participate in the auction for productive assets, the symmetric equilibrium quantity in the Cournot game with N firms is*

$$\hat{q} = \frac{S-c}{b(N+1)}. \tag{9}$$

Proof. In Appendix A.4. ■

Our model boils down to the standard Cournot equilibrium, similarly to the case of $p = 1$, when also outsider firms are interested in buying the PAs of the failing incumbent firms. Here competition yields no benefit as the Cournot quantity decreases with the number of incumbent firms in the industry. The intuition behind this result is explained in the next section.[10]

4 Comparative Statics

In this section we discuss how the amount of lending to the firms is affected by the degree of competition in the product market, *i.e.*, by the number N of incumbent firms at date 0. To this aim, we need to relate the Cournot equilibrium quantities, q^* in (6) and $\hat{q}$ in (9), with measures of credit availability. One possible measure is the proportion of debt issued to finance the investment, that is $L = (I - M)/I$. Recalling equation (1) and formulas (6) and (9), the equilibrium value of such proportion amounts to

$$L^* = \frac{cq^* - M}{cq^*} = 1 - \frac{M}{cq^*}, \tag{10}$$

when no outsiders are active in the relevant market and

$$\hat{L} = \frac{c\hat{q} - M}{c\hat{q}} = 1 - \frac{M}{c\hat{q}}, \tag{11}$$

[10] Interestingly, one can check that the equilibrium quantity equals

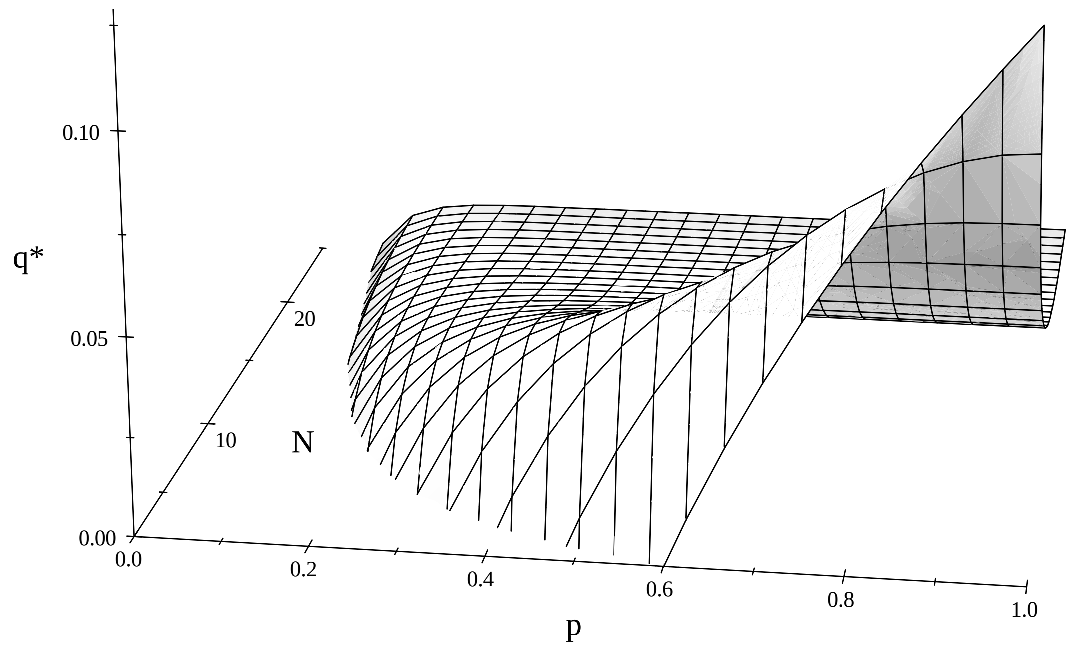
$$\frac{\left[1-(1-p)^N\right]S - c}{b\left[2+(N-1)\right]\left[1-(1-p)^N\right]}, \tag{a}$$

when only one outsider firm is willing to buy the PAs. The proof is available upon request.

when there are outsiders willing to bid for the PAs. The above expression shows that L^* and $\hat{L}$ increase with q^* and $\hat{q}$, respectively. Accordingly, we can derive predictions on how L^* and $\hat{L}$ are affected by the structure of the product market straight from the calculations of the derivatives of the equilibrium quantities q^* and $\hat{q}$ w.r.t. N.

We first deal with the case of no outsiders participating in the auction. Given the complicate formula of (6), we resort to numerical examples. With no loss of generality, we can normalize to 1 the two demand function parameters, S and b. Accordingly, Assumption 2 must be rewritten as $c \geq 0.5$. In Figure 1 we let $c = 0.6$ and draw the equilibrium quantity q^* in space (p, N, q^*).

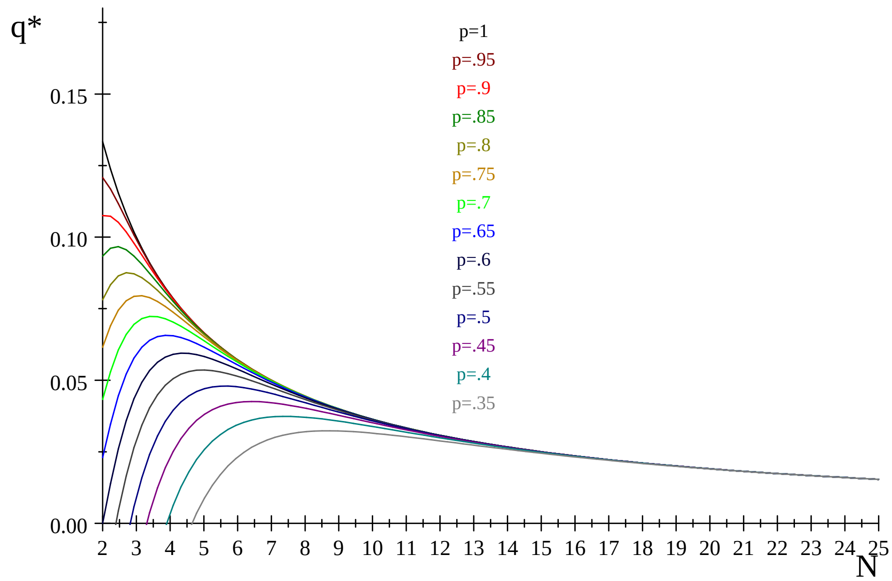
FIGURE 1



For readability, in Figure 2 we plot the equilibrium quantity q^* in plane (N, q^*) with p taking different values and $c = 0.6$.

Both figures show clearly that the relation between the equilibrium quantity q^* (and thus the proportion of new debt over investment L^*) and the number of firms N is non-monotonic, provided that p is not close to 1. More precisely, for small values of N tougher competition, *i.e.*, more firms active at date 0, might affect lending *positively*. By contrast, for large values of N tougher competition affects negatively the equilibrium quantities q^* and L^*.

Figure 2



This puzzling finding can be explained by the following trade-off. On the one hand, the equilibrium price $P_N \equiv S - b \times Nq^*$ decreases with N, thus shrinking q^* and L^*. This is the standard negative effect of competition on the Cournot quantity and, in turn, on the proportion of new debt on total investment. On the other hand, a potential positive effect arises as the probability of project's default is taken into account. Indeed, the banks face the risk of not selling the collateralized PAs of its failing clients. This happens only when all rivals are failing as well in which case there is lack of buyers. The probability of such inauspicious event is $(1-p)^N$, thus decreasing in N,

$$\frac{\partial (1-p)^N}{\partial N} = (1-p)^N \ln (1-p) < 0. \tag{12}$$

As a result, competition affects positively the expected PAs' liquidation value and, in turn, the levels of q^* and L^*.

Notice that $\lim_{N\to\infty} (1-p)^N = 0$ for any p. For high values of N the probability that no firm is healthy tends to zero, in which case the positive effect of competition on q^* and L^* becomes trivial and is outdone by the negative one. The same holds true for relatively high values of p because $\lim_{p\to 1} (1-p)^N = 0$ for any N.

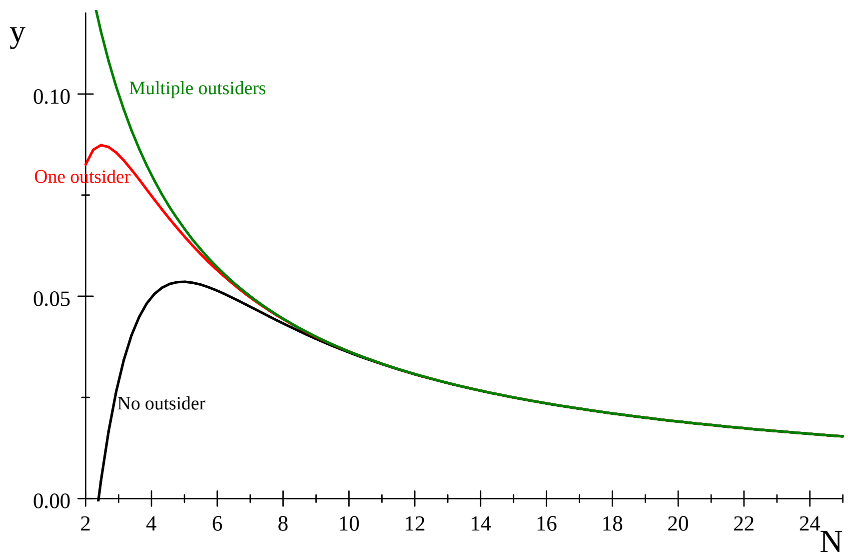
We now turn to the case of two or more outsiders participating in the auction for the PAs. As mentioned above, $\hat{L}$ and $\hat{q}$ are negatively affected by N for any given value of parameters S, c, and b. In this case the positive effect of competition is washed out. The reason lies in that the banks are always able to sell the PAs of its failing clients at the buyers' reservation price. When all rivals are failing, indeed, there are at least two outsiders that bid up to (8) to acquire the PAs.

Interestingly, this is not true if only one outsider is willing to buy the PAs. Indeed, relying on the argument of Section 3 we can state that the only outsider bids ε when there is no healthy insider. This is why the banks face the risk of not recovering a positive value when selling the PAs of their failing clients.

Accordingly, the Cournot equilibrium quantity (a), see Footnote 10, is affected by p and might be increasing in N as in the case with no outsider.

In Figure 3 we plot the three equilibrium quantities, (6), (a), and (9) as a function of N, given $p = 0.55$ and $c = 0.6$. Note that the equilibrium quantity with a single outsider, (a), lies in between the equilibrium quantity without outsiders, (6), and that with multiple outsiders, (9).

FIGURE 3



4.1 Predictions

The model presented in the previous sections allows us to derive predictions on the amount of credit available to firms by relating it to the structure of the product market where they operate. The predictions can be summarized by the following

Proposition 1 *(i) When only incumbent firms participate in the auction for productive assets, the relation between the equilibrium proportion of new debt on the investment,* L^**, and competition, in terms of number* N *of active firms at date* 0*, is non monotonic, provided that* p *is not close to* 1*: for relatively small values of* N*,* L^* *increases with* N*; for relatively large values of* N*,* L^* *decreases with* N *(ii) When at least two outsiders participate in the auction for productive assets, the equilibrium proportion of new debt on the investment,* $\hat{L}$*, decreases with* N*.*

In other words, Proposition 1 suggests under whicc parametric conditions a positive effect of greater PMC on credit available to firms willing to invest occurs. In addition it states that this result is affected by the presence of outside competitors who may find profitable to enter the market by acquiring the PAs on sale.

When testing our predictions on Italian firms, we must take into account few additional considerations derived from the model. First of all, the relation between additional debt and equilibrium quantity in (10) depends upon the amount of own funds M: hence firms with greater availability of inside funds can invest more for a given amount of debt. In addition there might be a minimum investment threshold $\overline{I}$ necessary to build an efficient plant, so that production takes place only if $I_i \geq \overline{I}$: then we might observe firms that choose not to invest. To summarize, in the empirical analysis it is important to take into account these sources of heterogeneity among firms. According to the first observation, the existence of different levels of own funds M implies that it is possible to observe firms that have invested although their decision was not affected by the mode of financing and the two choices were separate. As for the second, if there is a minimum level of investment to achieve efficiency then we might observe firms that did not invest although not financially constrained. To conclude, in the model credit availability is driven by the need to invest in productive projects, while in the empirical analysis the choice of investment and its mode of financing may not be perfectly correlated. This implies that it is crucial to have data reporting both the choice to invest and the way the investment is financed.

As a final observation, the model does not have implications for the total leverage of the firm, but simply the proportion of new debt raised to finance the investment: therefore we don't need information about total debt in the financial structure of firms - *i.e.*, the leverage - but indeed on the amount of additional borrowings related to a specific investment. Bearing all these remarks in mind, we can not turn to the empirical analysis.

5 Empirical test

The theoretical model investigates how greater PMC affects the level of investment when it is financed through collateralized debt. It underlines two contrasting effects: a negative one, due to shrinking profits and thus to the reduction in the pledgeable income for creditors, and a positive one, by enhancing the resale value of the asset pledged as collateral to creditors. These two contrasting effects have to be evaluated empirically in order to assess the overall impact of PMC on the amount of credit that banks are willing to extend to SMEs.

For this purpose we exploit the Survey on the access to finance of Italian Manufacturing Enterprises run by Unicredit Bank Group. Although the survey is run every three years, we use the 10th wave containing self-reported data for the years 2004-2006 on a representative sample of about 5000 manufacturing companies with more than 10 employees. In the survey each company is asked questions about the nature of investments and the way they have been financed. This information is then matched to the company accounting records taken from AIDA for the years 2000-2006. Moreover we know the location of the company and a detailed description of its core business. We can therefore tie each company in the sample to the competitive conditions of its local product market.

Due to missing values for some of the relevant variables we are left with 3,437 out of the 5,134 companies surveied (see Table 1). One of the questions in the survey is whether the firm has invested in equipments or machineries in the period 2004–2006. To the 2,514 companies who answered positively (73%), it asks how were those investments financed: 43% of them were entirely self-financed nor did resort to any medium to long term (ML, hereafter) bank debt, and finally 27% relied exclusively on ML bank debt. Notice that direct access to the bond market or to venture capital finance is extremely difficult for Italian SMEs, and in fact we don't observe it in our sample.

To be consistent with the theoretical model, we focus on ML bank debt, since this is the kind of debt typically requiring collateral. The collateral might be a productive asset, real-estate and other types of bank guaranties. Unfortunately we don't have information neither on the presence of collateral in the debt contract, nor on the type of the collateral (which might not be necessarily the same productive asset related to the investment). This type of information might be available only in credit registers reporting detailed information on individual debt contract.We therefore have to rely on imperfect information about the collateral. As a matter of fact we are forced to include as collateral also assets whose resale value might not be as sensitive to strong pressure by rivals in the product market. By doing so we are in the worst possible scenario to prove the relevance of PMC on external finance of SMEs and we are likely to be exposed to attenuation bias. So if we were to find any supporting evidence in favour of our theoretical model in our dataset, we could consider this to be a lower bound to the true effect should we be able to observe the true collateral.

Our theoretical model suggests that the mode of financing affects the decision to invest, hence we model these two correlated choices as a two part process: first whether to invest and to resort to debt, then, for those who decided to finance their investment with debt, we model the percentage of the investment to be financed with bank debt. We study the use of bank debt taking into account that the outcome of this choice is observable only for those companies that actually invested, and that their investment is potentially dependent upon the mode of financing it.

In the empirical exercise we follow a reduced form approach. 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 the test of the predictions of our theoretical model.

5.1 The econometric model

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).

More specifically, for the first part of the problem we apply a probit model with sample selection[11]. The choice of investing and then, conditionally on investing, the choice of financing it with ML debt are described by:

$$I_i = \mathbf{1}\left(x'_{1i}\beta_1 + \varepsilon_{1i}\right) > 0 \quad D_i = \begin{cases} \mathbf{1}\left(x'_{2i}\beta_2 + \varepsilon_{2i} > 0\right) & \textit{if } I_i = 1 \\ \textit{not observed} & \textit{if } I_i = 0 \end{cases} \tag{13}$$

where I_i is a dummy equal to 1 if company i undertakes any investment in equipments or machinery in the interval 2004-2006, and zero otherwise; D_i is equal to 1 if company i raises new ML bank debt[12] to

[11] See Van de Ven and Van Pegg (1981) among others for the use of probit models with sample selection.

[12] It is important to stress that D is the additional bank debt and not the company's total leverage as reported in its balance sheet. Our variable D refers to the new debt raised specifically to finance this investment, while leverage refers to the total stock of debt, cumulated over the past years and that has not reached its maturity yet, that was raised for other reasons by the company. This makes our dataset based on surveys more suitable for testing our model compared to other sources relying on

finance these specific investments; $\mathbf{1}(.)$ is an indicator function, which equals 1 whenever the condition inside brackets holds true; x_{1i} and x_{2i} are $k_1 \times 1$ and $k_2 \times 1$ vectors of observable characteristics of company i. Finally the error components ε_{1i} and ε_{2i} are jointly normally distributed according to:

$$\begin{pmatrix} \varepsilon_{1i} \\ \varepsilon_{2i} \end{pmatrix} | x_{1i}, x_{2i} \sim N \left\{ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right\}$$

Once the company has invested and resorted to new ML debt (*i.e.*, $I_i = 1$ and $D_i = 1$), it has to choose the percentage of the investment financed with ML debt, i.e. $L_i \in (0, 100\%]$.

We model this second part of the problem according to the following functional form:

$$\ln L_i = \begin{cases} x'_{3i}\beta_3 + \varepsilon_{3i} & \text{if } x'_{3i}\beta_3 + \varepsilon_{3i} < \ln 100 \\ \ln 100 & \text{if } x'_{3i}\beta_3 + \varepsilon_{3i} \geq \ln 100 \end{cases} \tag{14}$$

with $\varepsilon_{3i} \mid (x_i, I_i \times D_i = 1) \sim N(0, \sigma^2)$, where $x_i = (x'_{1i}, x'_{2i}, x'_{3i})'$ is the $(k_1 + k_2 + k_3) \times 1$ vector of all the variables included in the model.

Writing the likelihood function is straightforward as it breaks the problem into two separate models: a probit model with sample selection on the full sample and a tobit model on a limited set of observations, that is those for which $I_i \times D_i = 1$.

This empirical strategy allows us to investigate how PMC might affect the access to credit not only for those companies that actually resorted to ML debt, but also for those that have not. Infact exploiting the two-part model we can express the expected percentage of investment financed with new ML debt on the entire population of companies as:

$$E[L_i|x_i] = \Pr(I_i \times D_i = 1|x_i) \exp\left(E[\ln L_i|x_i, I_i \times D_i = 1] + \frac{\sigma^2}{2} \right) \tag{15}$$

Equation (15) implies that for any company i a change in any explanatory variable k included in x_i, defined as x_i^k, may be decomposes into two different effects on L_i: either by changing the probability that company i finances the investment with debt, given by $\Pr(I_i \times D_i = 1|x_i)$, and/or by affecting the percentage of additional debt given that the company is already a borrower, $E[\ln L_i|x_i, I_i \times D_i = 1]$. The marginal effect of x_i^k on $E[L_i|x_i]$ is therefore a function of the overall parameters in both parts of the empirical model $\theta = (\beta'_1, \beta'_2, \beta'_3, \sigma^2)'$, more specifically:

$$\begin{aligned} \frac{\partial E[L_i|x_i]}{\partial x_i^k} &= E[L_i|x_i] \left[\frac{\partial \Pr(I_i \times D_i = 1|x_i)}{\partial x_i^k} \frac{1}{\Pr(I_i \times D_i = 1|x_i)} \right. \\ &\quad \left. + \beta_3^k \Pr(L_i < 100|x_i, I_i \times D_i = 1) \right]. \end{aligned} \tag{16}$$

As it is evident from the expression above, we could not evaluate the marginal effects of various factors on the percentage of ML debt, unless we observed either the investment decision and its mode of financing. If we

accounting data. With accounting data we could measure the amount of company outstanding debt, eventually its variation over time, but we could never associate it to a specific investment. As a matter of fact this association is crucial for our purpose, given that we focus on investments (and collaterals) tied to the specific economic activity of the company. We therefore need to distinguish between equipment or machinery investments (and related loans) – which are clearly activity specific – and other less specific investments (*e.g.,* real estate, and related loans). We must be able to associate a specific investment to the way it is financed, this is why we require information on the incremental debt and not on the total outstanding debt of the firm as recorded in the balance sheet.

had used credit register data reporting information on companies' debt contract, borrowers' characteristics and the nature of the collateral we would miss information on companies that did not invest or self-financed their investments. This creates a potential issue of endogeneity in sample selection, given that investment and financing strategies are in fact joint decisions, and the results of our model could not be extended to the entire population of companies. Thus we could not study the impact of PMC on external finance for SMEs since these data do not provide information on companies that have not invested or have self-financed their investment, as in our source of data covering both investing and not investing firms.

We now turn to the choice of explanatory variables to be included in the empirical analysis. A first set of explanatory variables controls for the financial structure and profitability at the beginning of the reference period, that is at the end of the year 2003. More specifically we include in x_{ji} with $j = \{1, 2, 3\}$ accounting information to control for firm's size (measured as (log of) turnover), leverage (defined as the ratio of total debt over total assets), the ratio of fixed to total assets and profitability (measured as ROA). We also compute for each company in the sample the z-score proposed by Altman (2002) as a measure of the company's riskiness based on accounting variables.[13] A low z-score is considered to be a predictor of a high probability of default (p) which itself might affect the percentage of the investment financed with debt according to our theoretical model.

The structure of the product market, our main concern, is captured by the (log of the) Herfindahl index computed on the distribution of plants in the same 2-digit Ateco industry and in the province where the company is located. According to our theoretical model, tougher competition, captured by a lower Herfindahl index, may enhance the value of the collateral in case of default, and thus may be associated to a larger availability of credit to firms. This effect might be stronger if the main competitors (which are the potential buyers of the productive asset in case of default) are all within the region. In fact the model predicts that the very existence of rivals outside the local market willing to bid for the productive asset in order to enter the industry reduces the beneficial effect of product market competition on debt. We therefore add a dummy variable which equals one if all competitors are located in the same region of the company and furthermore we interact it with the log of the Herfindahl index for the local product market.

Finally, we include dummy variables to indicate whether the company is listed in the stock market, whether it is younger than 10 years ($age < 10$) or part of a larger industrial group. We control for the degree of competition in the banking sector in the market where the firm is located by including also the Herfindahl index on bank branches.[14]

In order to better identify the parameters of the model, we consider a set of variables to be included in (x_1, x_2) but not in x_3, that is, variables which determine whether to invest and to resort to debt, but that

[13] The z-score is computed using the following formula:

$$\text{z-score} = 6.56 f_1 + 3.26 f_2 + 6.72 f_3 + 1.05 f_4$$

where f_1 is the ratio between working capital and total assets, f_2 is the change in "other shareholders funds" over total assets between 2002 and 2003, f_3 is the ratio between EBIT and total assets, and f_4 is the ratio between shareholders funds and the sum of non current liabilities plus current liabilities.

[14] This information is borrowed from Cerasi et al. (2009) where the number of branches of individual banks in each local market is used to estimate an index of competition in the banking sector.

do not affect the choice of the amount of debt, once the decision to resort to debt has been taken. These are industry dummy variables (2-digit Ateco codes) and a measure of the liquidity of the company given by the (log of the) ratio between the reserves and total assets. For the same reason we include the (log of the) number of employees and the (log of the) fixed assets to turnover ratio in x_1 but not in x_2 and x_3. That is, we assume that labor and capital intensity affect the investment decision, but not the amount of debt, conditional on having invested.

5.2 Results

The sample average of the explanatory variables are reported in Table 1, where the observations are divided into subsets according to the different choices of investing and raising external debt.

[Insert Table 1 here]

The companies in our sample had at the end of 2003 on average a turnover between 4.4 and 8.7 millions of Euro, with those not investing being the smallest ones. The ROA was about 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 Italian SMEs, although relatively large, with a long history and mainly operating in traditional sectors. About 30% of those not investing in the period 2004-2006, have only local competitors, that is rivals within the boundaries of their region. This percentage drops to 22% among those investing. The competitiveness in the local banking market seems not to differ between companies that invested compared to those that have not invested. On the contrary, the local product markets of the investing companies are more concentrated than those not investing.

The pseudo-maximum likelihood estimates of the probit model with sample selection and the tobit model are presented in Table 2.[15] Given the non-linearity of the empirical model, the effect of the covariates on the outcomes can be better captured by the average marginal effects shown in Table 3 to which we refer from now on.

[Insert Table 2 and 3 here]

The results in column (1) refer to the estimation of the two equations in (13) and show that the probability of investing increases with the profitability and the company age, may be for the need to replace old equipments. Ceteris paribus, companies with higher fixed assets over turnover and more personnel in 2003 are more likely to invest in equipments and machineries in the subsequent period, i.e. between 2004 and 2006. Firms with only regional competitors are remarkably less likely to invest.

The probability of using bank debt to finance a specific investment during the period 2004–2006, as reported in column (2), increases with the amount of leverage at the end of 2003 and it is higher for independent companies that cannot rely on intra-group transfers. The more liquidity has the company

[15] We use a pseudo maximum likelihood approach instead of a standard maximum likelihood in order to take into account the possible correlations across observations induced by the presence of market-specific explanatory variables.

the more it resorts to debt, probably because banks expect a higher solvency to be associated with greater liquidity. Once controlling for all other indicators, the z-score does not predict neither the investment choice, nor the mode of financing it.

A greater competition in the local banking market, defined as a lower concentration index, increases the likelihood that the investment will be financed with bank debt. The structure of the bivariate probit model allows us to better identify the channel through which the explanatory variables affect the probability of the joint event $\Pr(I_i = 1, D_i = 1|x_i)$ in column (4), defined as the product of $\Pr(D_i = 1|I_i = 1, x_i)$ in column (3) and $\Pr(I_i = 1|x_i)$ in column (1) applying Bayes' rule. We can observe for instance that such a probability increases with the ROA due to the positive effect on the probability to invest, although its effect on the choice of debt is negligible. The reverse holds for the Herfindahl index in the local banking market, which is relevant for $\Pr(D_i = 1|x_i)$ and $\Pr(D_i = 1|I_i = 1, x_i)$ but not for the joint probability.

The estimated measure of correlation between the two choices, ρ, takes value -0.53 according to Table 2. The negative sign suggests that the decision to invest and financing it with debt are inversely, although not perfectly, correlated: ceteris paribus, the greater the probability to invest, the smaller the probability to finance it with bank debt. This evidence proves that Italian SMEs tend to self-finance their investments because of the existence of a premium on external finance for SMEs, similarly to cross-country evidence in the survey by Beck et al. (2006).

We now analize the percentage of the investment financed with new bank debt, focusing on those companies that actually financed their investment with bank debt (*i.e.*, those with $I_i \times D_i = 1$). The last columns of Tables 2 and 3 show the results for this second part of the model given by the estimation of equation (14). The percentage of new debt is higher the smaller the companies and the greater the leverage in 2003. The previous results on bank sector concentration are confirmed here, but what is more relevant for our aim is how the Herfindahl index for the product market affects the percentage of debt for these companies: the more concentrated is the product market the lower is the percentage of debt. Furthermore the effect is much stronger for those companies not having competitors outside their area (with an elasticity of -0.04 versus -0.01) as shown in Table 3 column (6).

We now use the estimated parameters in Table 2 togheter with the value of the observable characteristics x_i to predict the impact of PMC on the percentage of ML debt over investment for the entire sample of companies. For each firm in the sample, regardless of whether it has invested or raised debt, we compute the semi-elasticity $\partial E[L_i|x_i] / \partial \ln H_i$, that is how a 1% change in H affects the percentage of new debt, according to equation (16). The average semi-elasticity for the entire sample (also for companies that have not invested nor raised debt) is estimated to be -3.1, that is a 1% reduction in the Herfindahl index increases the percentage of the investment financed with debt by 3.1 points. The average semi-elasticity is -0.8, but not statistically different from zero for those companies with competitors outside the regional boundaries, while it is -3.1, and statistically different from zero for those companies with only local competitors. Furthermore, the effect is stronger for the firms that have actually invested and financed their investment with debt (-3.3), but it is also potentially relevant for those investors who did not resort to medium-long bank debt (-3.1) and for the non-investors (-2.8).

We also considered all possible interactions between explanatory variables related to the structure of the product market and the z-score, but none of these interactions proved to be statistically significant. Since the z-score is a measure of the ex-ante credit worthiness of firms and it is actually captured, among other things, by the real amount of debt and profitability, its interaction with other variables does not add explanatory power to the previous model.

In conclusion, our results show that companies facing competitive conditions in their local product markets are capable of attracting more debt to finance their investment and that this effect is stronger the fewer are the direct competitors outside the local market. This piece of evidence is fully consistent with the predictions of our theoretical model.

These results are important for their policy implications: to reduce credit rationing it may be relevant to strenghten competition in the product market, whenever creditors base their credit analysis also on the resale value of collaterals.

6 Concluding Remarks

In this paper we present a model that relates credit conditions to the structure of the product market in which firms operate not only through the standard effect on prices but also through the resale value of the productive assets used as collateral in the loan contract. Since the resale value of productive assets is enhanced by their liquidity, having more rivals in the industry boosts the value of PAs in case of liquidation. However more competition shrinks profits. The final effect on the pledgeable income to creditors is the result of the above trade-off. We suggest possible determinants of the trade-off and leave to the empirical analysis the task of measuring its actual impact on financial conditions for SMEs. In the empirical analysis on Italian SMEs we test the effect of product market conditions on the ability to raise external debt. We provide supportive evidence to our theoretical result, in that companies facing greater product market competition and without outside bidders succeed in raising more bank debt to finance their investments.

In the theoretical model we make several restrictive assumptions for analytical tractability. For instance we assume independence across defaults for all firms in the market: this assumption is indeed relaxed in the empirical analysis. Furthermore we assume independence between probability of default and product market competition. If competition increases the probability of default our mechanism might even be stronger. However if the opposite was true our result might be weakened. The link between firms' default rates, product market competition and bank debt has been preliminarly analyzed within our empirical model, by introducing the degree of riskiness of companies measured with the z-score; however we have not found any significative evidence in support to this relation.

References

[1] Acharya V., Bharath S., Srinivasan A., 2007, Does Industry-wide Distress Affect Defaulted Firms? Evidence from Creditor Recoveries, *Journal of Financial Economics*, 85(3), 787-821.

[2] Almeida H., Campello M., Hackbarth D., 2009, Liquidity Mergers, AFA 2010 Atlanta Meetings Paper. Available at SSRN: http://ssrn.com/abstract=1362327

[3] Altman, E., 2002, Predicting Financial Distress of Companies: Revisiting the Z-Score and Zeta Models, New York University Working Papers.

[4] Amemiya T., 1985, Advanced Econometrics. Harvard University Press.

[5] Beck T., Demirguc-Kunt A., 2006, Small and Medium-size Entreprises: Access to Finance as a Growth Constraint, *Journal of Banking and Finance,* 30 (11), 2931-2943.

[6] Benmelech E. and N.K. Bergman, 2009, Collateral Pricing, *Journal of Financial Economics,* 91(3), 339-360.

[7] Benmelech E. and N.K. Bergman, 2011, Bankruptcy and the Collateral Channel, *Journal of Finance,* 66 (2), 337-378.

[8] Berger A. and G. Udell, 1995, Relationship Lending and Lines of Credit in Small Firm Finance, *The Journal of Business,* 68 (3), 351-381.

[9] Brander J. and T. Lewis, 1986, Oligopoly and Financial Structure: The Limited Liability Effect, *American Economic Review*, 76 (5), 956-970.

[10] Cerasi V., Chizzolini B., and Ivaldi M., 2009, The impact of mergers on the degree of competition in the banking industry, CEPR Discussion Paper No. 7618.

[11] Cerasi, V. and A. Fedele, 2011, Does Product Market Competition Increase Credit Availability?, *The B.E. Journal of Economic Analysis & Policy*, Vol. 11: Iss. 1 (Topics), Article 41.

[12] Colombo M. and Grilli L., 2007, Funding Gaps? Access To Bank Loans By High-Tech Start-Ups, *Small Business Economics,* 29(1), 25-46.

[13] Gavazza A., 2010, Asset Liquidity and Financial Contracts: Evidence from Aircraft Leases, *Journal of Financial Economics,* 95(1), 62-84.

[14] Habib M. and B. Johnsen, 1999, The Financing and Redeployment of Specific Assets, *Journal of Finance*, 54 (2), 693-720.

[15] Holmstrom B. and J. Tirole, 1997, Financial Intermediation, Loanable Funds and the Real Sector, *Quarterly Journal of Economics*, 112 (3), 663-691.

[16] Ortiz-Molina H. and G. Phillips, 2009, Asset Liquidity and the Cost of Capital, Available at SSRN: http://ssrn.com/abstract=1413780

[17] Rajan R., 1992, Insiders and Outsiders. The Choice between Informed and Arm's-Lenght Debt, *Journal of Finance,* 48(4), 1367-1400.

[18] Rajan R., Zingales L., 1998, Financial Dependence and Growth, *American Economic Review,* 88 (3), 559-586.

[19] Shleifer A. and R. Vishny, 1992, Liquidation Values and Debt Capacity: a Market Equilibrium Approach, *Journal of Finance*, 47(4), 1343-1366.

[20] Van de Ven W. P. M. M., and Van Pragg B. M. S., 1981, The demand for deductibles in private health insurance: A probit model with sample selection, *Journal of Econometrics,* 17, 229–252.

A Computations and Proofs

A.1 Computation of (3)

To compute (3), we first write the firm 1's expected revenue at date 0

$$U_1 = p\left(P_3 q_1 - r_1\right) + p\left\{p^2 \times 0 + \left[p\left(1-p\right)\frac{1}{2}P_3\overline{q} + \left(1-p\right)p\frac{1}{2}P_3\overline{q}\right] + \left(1-p\right)^2 P_3\left(2\overline{q}\right)\right\} \tag{17}$$
$$+ \left(1-p\right) \times 0 - M.$$

When firm 1 is healthy (with probability p), it earns $P_3 q_1$ and repays r_1 to the bank according to the loan agreement described in Section 2. In addition, when both rivals are healthy (with probability p^2) there are no PAs for sale, hence firm 1 earns no extra-profits. When either firm 2 or firm 3 fails (with probability $p\left(1-p\right)$ each) firm 1 acquires the failing rival's PAs with probability $\frac{1}{2}$ and the extra-gain is $P_3\overline{q}$. When both rivals fail (with probability $(1-p)^2$) firm 1 buys the two PAs of failing rivals and the extra-gain is $P_3 2\overline{q}$. By contrast, when firm 1 fails (with probability $(1-p)$) it earns nothing due to limited liability. Finally, M denotes the opportunity cost of firm 1's own funds.

To calculate the expected profit of the bank lending to firm 1, denoted by V_1, we define H (resp. $2-H$) the number of firm 1's rivals, firms 2 and 3, whose banks receive a positive (negative) signal at date 1/2. Relying on the argument developed in Section 3 and on the above notation we sum up the equilibrium bids for a single failing firm's PAs:

$$v_3\left(1, H\right) \equiv \begin{cases} 0 & \text{if } H = 2, \\ P_3\overline{q} & \text{if } H = 1, \\ \varepsilon & \text{if } H = 0 \end{cases} \quad \text{or } v_3\left(0, H\right) \equiv \begin{cases} P_3\overline{q} & \text{if } H = 2 \\ \varepsilon & \text{if } H = 1, \\ 0 & \text{if } H = 0. \end{cases} \tag{18}$$

The argument within brackets $(1, H)$ indicates that firm 1 plus H firms are healthy, whilst $(0, H)$ that firm 1 is failing and H firms, beside firm 1, are healthy. Note that $v_3\left(1,1\right)$ (and similarly $v_3\left(0,2\right)$) is obtained by (2) after plugging $N = 3$, $H = 1$ and $\overline{q}$ instead of q^*.

We can write

$$V_1 = p\left\{r_1 - \left[p\left(1-p\right)\frac{1}{2}v_3\left(1,1\right) + \left(1-p\right)p\frac{1}{2}v_3\left(1,1\right)\right] - \left(1-p\right)^2\left(v_3\left(1,0\right) + v_3\left(1,0\right)\right) - p^2 v_3\left(1,2\right)\right\}$$
$$+\left(1-p\right)\left[p^2 v_3\left(0,2\right) + 2p(1-p)v_3\left(0,1\right) + \left(1-p\right)^2 v_3\left(0,0\right)\right] - \left(I_1 - M\right).$$

When firm 1 is successful (with probability p) the bank receives r_1. Moreover, when either rival 2 or 3 fails (with probability $p\left(1-p\right)$ each) the bank lends an extra amount $\frac{1}{2}v_3\left(1,1\right) \equiv \frac{1}{2}P_3\overline{q}$ to firm 1 that acquires the PAs of the failing rival, 1/2 being the probability that firm 1 is actually awarded firm j's PAs, $j = 2, 3$. With probability $\left(1-p\right)^2$ the bank funds the price $v_3\left(1,0\right) + v_3\left(1,0\right) \equiv 2\varepsilon$ to acquire the PAs of both failing rivals in a single-buyer auction. When both rivals are healthy (with probability p^2) no trade of PAs occurs, thus $v_3\left(1,2\right) \equiv 0$.

By contrast, firm 1 fails with probability $1-p$ and: when both rivals are healthy (with probability p^2), the bank sells firm 1's PAs at price $v_3\left(0,2\right) \equiv P_3 q_1$ in a multiple-buyer auction; with probability $2p\left(1-p\right)$ only one rival, either 2 or 3, is healthy and buys at price $v_3\left(0,1\right) \equiv \varepsilon$ in a single-buyer auction; with probability $\left(1-p\right)^2$ both rivals are failing, in which case the PAs cannot be sold, $v_3\left(0,0\right) \equiv 0$. Finally, last term $I_1 - M$ is the opportunity cost of the amount lent to firm 1.

Substituting $I_1 = cq_1$ from (1) and equilibrium bids from (18), the bank's revenue V_1 can be written as

$$V_1 = pr_1 + p^2\left(1-p\right)P_3\left(q_1 - \overline{q}\right) - \left(cq_1 - M\right). \tag{19}$$

Recall that at date 0 firm 1 sets quantity q_1 and repayment r_1 with the aim of maximizing U_1, given the bank's participation constraint $V_1 \geq 0$ and taking as given the quantity set by other rivals. The expected profit U_1 is decreasing in r_1. As a consequence, r_1 is set as low as possible. Since V_1 instead increases with r_1, constraint $V_1 \geq 0$ must be binding at the symmetric Cournot equilibrium. Solving $V_1 = 0$ by r_1 and substituting it into (17) gives, after rearranging, (3).

A.2 Computation of (5)

The following table represents the possible alternative scenarios concerning the incumbents' state of health after date 1/2 and the corresponding probabilities according to the binomial distribution.

	firm i is healthy	firm i is failing
H firms are healthy and $(N-1-H)$ are failing	$p \times \binom{N-1}{H} p^H (1-p)^{N-1-H}$	$(1-p) \times \binom{N-1}{H} p^H (1-p)^{N-1-H}$

The first (second) term of the product in each cell indicates the probability that the event in the corresponding column (row) occurs. For instance, the event "H firms are healthy and $N-1-H$ are in distress" occurs $\binom{N-1}{H}$ times, each one with probability $p^H (1-p)^{N-1-H}$.

Firm i's expected profit U_i is computed as follows. With probability $(1-p)$ firm i fails, hence its returns go to zero due to limited liability. By contrast, with probability p firm i actually competes in the product market by gaining $P_N q_i$ and repaying r_i at date 1 according to the loan agreement described in Section 2. In addition, firm i earns the following extra-revenue

$$\sum_{H=0}^{N-1} \binom{N-1}{H} p^H (1-p)^{N-1-H} \frac{1}{H+1} P_N (N-1-H) q^* : \tag{20}$$

when $N-1-H$ rivals are in distress, firm i is awarded PAs of all distressed rivals with probability $\frac{1}{H+1}$. Summing up, firm i's expected revenue is:

$$U_i \equiv p (P_N q_i - r_i) + p \sum_{H=0}^{N-1} \binom{N-1}{H} p^H (1-p)^{N-1-H} \frac{1}{H+1} P_N (N-1-H) q^* - M, \tag{21}$$

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

To derive V_i, the expected revenue accruing to the bank lending to firm i, we first write the equilibrium bids for a single failing firm's PAs when there are $N \geq 2$ initial firms in the industry:

$$v_N(1,H) \equiv \begin{cases} 0 & \text{if } H = N-1, \\ P_N q^* & \text{if } H \in [1, N-2], \\ \varepsilon & \text{if } H = 0, \end{cases} \quad \text{and } v_N(0,H) \equiv \begin{cases} P_N q^* & \text{if } H \in [2, N-1], \\ \varepsilon & \text{if } H = 1, \\ 0 & \text{if } H = 0, \end{cases} \tag{22}$$

The above values are borrowed from (18), *mutatis mutandis*. V_i is calculated as follows. 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 liquidation value $v_N(0,H)$ from an auction with H bidding firms over N initial competitors. In symbols

$$\begin{aligned} V_i \equiv\, & p \left[r_i - \sum_{H=0}^{N-1} \binom{N-1}{H} p^H (1-p)^{N-1-H} \frac{1}{H+1} (N-1-H) v_N(1,H) \right] \\ & + (1-p) \left[\sum_{H=0}^{N-1} \binom{N-1}{H} p^H (1-p)^{N-1-H} v_N(0,H) \right] - (I_i - M), \end{aligned} \tag{23}$$

where $I_i - M$ is the opportunity cost of the amount lent. Substituting the equilibrium bids from (22), the bank's expected revenue on the loan to firm i can be rewritten as:

$$V_i \equiv p\left[r_i - \sum_{H=1}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H}\frac{1}{H+1}P_N(N-1-H)q^* - (1-p)^{N-1}(N-1)\varepsilon\right]$$
$$+(1-p)\left[(N-1)p(1-p)^{N-2}\varepsilon + \sum_{H=2}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H}P_N q_i\right] - (I_i - M).$$

Recall that firm i's problem is as follows

$$\max_{q_i, r_i} U_i \qquad (24)$$
$$\text{s.t. } V_i \geq 0 \text{ and } q_j = q^* \text{ for all } j \neq i.$$

We know that constraint $V_i \geq 0$ is binding at the solution to problem (24). Solving $V_i = 0$ by r_i and substituting into (21) gives

$$U_i = \left[p + (1-p)\sum_{H=2}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H}\right]P_N q_i + p(1-p)^{N-1}P_N(N-1)q^* - cq_i. \qquad (25)$$

Finally, observe that

$$\sum_{H=2}^{N-1}\binom{N-1}{H}p^H(1-p)^{N-1-H} = 1-(1-p)^{N-1} - (N-1)p(1-p)^{N-2} \qquad (26)$$

according to the Binomial density formula. Substituting (26) into (25) yields expression (5).

A.3 Proof of Lemma 2

Suppose any firm i is healthy. Two cases where the transfer of PAs may occur must be considered separately.

1) Assume that all $N-1$ rivals fail. In this case firm i is the only potential bidder. If it does not participate in the auction, it gets $P_1 \times q^*$, where q^* is the symmetric N-oligopoly Cournot equilibrium quantity and $P_1 \equiv S - b \times q^*$ indicates the demand function when all the failing firms' PAs are lost and exit the market. If, instead, firm i participates and bids for $M \in [1, N-1]$ PAs the revenue is $P_{M+1} \times (M+1)q^*$. As a result, when

$$P_N N q^* \geq P_{N-1}(N-1)q^* \qquad (27)$$

firm i is willing to participate in the auction and bid for all $N-1$ PAs. Recalling that $P_N = S - b \times Nq^*$ inequality (27) becomes $S \geq b(2N-1)q^*$. Plugging the equilibrium quantity q^* computed in Lemma 1 and rearranging yields

$$c \geq S\frac{(N-2)\left(1-(1-p)^{N-1}\right) - p(1-p)^{N-1}\left(N^2-3N+3\right)}{2N-1}. \qquad (28)$$

The RHS of (28) increases monotonocally with $N \geq 2$ and

$$\lim_{N\to\infty} S\frac{(N-2)\left(1-(1-p)^{N-1}\right) - p(1-p)^{N-1}\left(N^2-3N+3\right)}{2N-1} = \frac{S}{2}.$$

Accordingly, $c \geq \frac{S}{2}$ implies (27) for any N.

2) Assume now that firm i plus $H \geq 1$ rivals are healthy, so that $H+1 \geq 2$ firms may participate in the auction to buy $N-1-H$ PAs of the failing competitors. Recall that bids are simultaneous, the healthy firms play thus the following game, where for simplicity only firm i's payoff is written:

firm $i\backslash H \geq 1$ healthy rivals	$H \geq 1$ rivals bid	no rival bids
bid	$\frac{1}{H+1} P_N (N-H) q^* + \left(1 - \frac{1}{H+1}\right) P_N q^*$	$P_N (N-H) q^*$
no bid	$P_N q^*$	$P_{H+1} q^*$

Note that payoffs are computed under the hypothesis that any firm participating in the auction bids for all the available PAs, as implied by $c \geq \frac{S}{2}$. If $H+1$ firms play "bid", they are willing to pay the same reservation value (2). Accordingly, there is a tie in the bids, in which case, the ownership of the (indivisible) PAs is randomly allocated to a single bidder. The expected revenue for firm i is thus: $P_N (N-H) q^*$ when it wins the auction - this occurs with probability $\frac{1}{H+1}$ - because it obtains $N-1-H$ PAs of the failing competitors; $P_N q^*$ when it does not win the auction - this occurs with probability $1 - \frac{1}{H+1}$. It is easy to check that "bid" is a dominant strategy if $P_N (N-H) \geq P_{H+1}$, which holds true under condition (27) since $P_N (N-H) = P_{H+1+N-1-H} (N-H) \geq ... \geq P_{H+1+1} 2 \geq P_{H+1}$.

A.4 Proof of Lemma 3

We study the auction where also outsiders are potential participants. First note that the incumbent firms have a higher reservation value than the outsiders due to cost E borne only by the latter. Two differences arise compared to the scenario without outsiders. When only one insider is healthy, we rely on the Bertrand argument of Section 3 to assume it outbids by ε the outsider's reservation value (8). When all insiders fail, the outsiders compete by bidding up to (8). The equilibrium bids for a failing firm's PAs are thus

$$v_{N,O}(1,H) \equiv \begin{cases} 0 & \text{if } H = N-1, \\ P_N \hat{q} & \text{if } H \in [1, N-2], \\ P_N \hat{q} - E + \varepsilon & \text{if } H = 0 \end{cases} \quad \text{and } v_{N,O}(0,H) \equiv \begin{cases} P_N \hat{q} & \text{if } H \in [2, N-1], \\ P_N \hat{q} - E + \varepsilon & \text{if } H = 1, \\ P_N \hat{q} - E & \text{if } H = 0, \end{cases} \tag{29}$$

where recall that $\hat{q}$ is the symmetric Cournot equilibrium quantity with multiple outsiders.

Representative firm i's expected revenue is as in (21). On the contrary, expected return of the bank lending to firm i is given by (23) after substituting (29):

$$V_i \equiv p \left[r_i - \sum_{H=1}^{N-1} \binom{N-1}{H} p^H (1-p)^{N-1-H} \frac{1}{H+1} (N-1-H) P_N \hat{q} - (1-p)^{N-1} (P_N \hat{q} - E + \varepsilon) \right]$$
$$+ (1-p) \left[\sum_{H=0}^{N-1} \binom{N-1}{H} p^H (1-p)^{N-1-H} P_N q_i - (1-p)^{N-1} E - (N-1) p (1-p)^{N-2} (E - \varepsilon) \right] - (I_i - M).$$

Rearranging yields

$$V_i = p \left[r_i - \sum_{H=0}^{N-1} \binom{N-1}{H} p^H (1-p)^{N-1-H} \frac{1}{H+1} (N-1-H) P_N \hat{q} \right]$$
$$+ (1-p) \left(\sum_{H=0}^{N-1} \binom{N-1}{H} p^H (1-p)^{N-1-H} P_N q_i - (1-p)^{N-1} E \right) - (c q_i - M)$$

Given that the lender's individual rationality constraint is binding, we solve $V_i = 0$ by r_i and plug the result into (21) by getting the following expected surplus,

$$U_{i,O} = P_N q_i - (1-p)^N E - c q_i. \tag{30}$$

When we take the derivative of $U_{i,O}$ w.r.t q_i and solve for $q_i = \hat{q}$ we obtain the equilibrium quantity in Lemma 3.

Table 1: descriptive statistics. Averages of the explanatory variables by investment and debt regimes.

	No investment	Investment	
Variables		No bank debt	With bank debt
Not part of a group	0.8472	0.7426	0.8020
Age < 10 yrs	0.1419	0.0852	0.1032
zscore_03	5.5461	5.4974	5.2713
Leverage03	0.6632	0.6174	0.6717
Ln(Turnover03)	1.6362	2.1680	2.0313
FixTotAss03	0.2025	0.2316	0.2384
ROA03	0.0387	0.0495	0.0408
Listed	0.0098	0.0213	0.0098
H local credit market	0.1628	0.1681	0.1632
Local competitors only	0.3034	0.2278	0.2162
ln(H local industry)	-4.8142	-4.6664	-4.6995
Ln(Reserves/TotAssets03)	-2.7465	-2.6212	-2.7945
Ln(# employees)	3.2796	3.8190	3.7379
Ln(FixedAssets/Turnover03)	4.7147	4.9943	5.0354
N. observations	923	1080	1434

Table 2: Pseudo Maximum likelihood estimates.
Two-way cluster adjusted standard errors in parentheses (by province and 2-digit Ateco codes). Equation for *I* and *D* include industry dummy variables

VARIABLES	(1) I	(2) D	(3) lnL
Not part of a group	-0.0292	0.1914***	-0.0148
	(0.0415)	(0.0666)	(0.0737)
Age < 10 years	-0.1610***	0.1004	0.0082
	(0.0464)	(0.0746)	(0.0810)
zscore_03	0.0227	-0.0151	0.0326
	(0.0240)	(0.0545)	(0.0475)
Leverage03	0.3409*	0.9027***	0.4052*
	(0.2057)	(0.2582)	(0.2190)
Ln(Turnover03)	0.0397	-0.0443*	-0.1786***
	(0.0320)	(0.0240)	(0.0259)
FixTotAss03	0.1790	-0.0508	0.3093
	(0.2741)	(0.4382)	(0.3544)
ROA03	1.3025***	-0.1756	-0.2424
	(0.3771)	(0.3733)	(0.5434)
Listed	-0.1616	-0.2165	0.3134
	(0.2653)	(0.1687)	(0.3984)
H local credit market	0.1249	-0.6277***	-0.6671***
	(0.3796)	(0.1952)	(0.2539)
Local competitors only	-0.0628	-0.3168	-0.2759
	(0.1877)	(0.2505)	(0.2034)
ln(H local industry)	-0.0196	0.0373	-0.0282
	(0.0232)	(0.0310)	(0.0197)
Local competitors only *	0.0591	-0.0639	-0.0797**
ln(H local industry)	(0.0368)	(0.0463)	(0.0391)
Ln(Reserves/Tot Assets)	-0.0115	0.0301**	
	(0.0153)	(0.0122)	
ln(# employees)	0.2455***		
	(0.0479)		
ln(Fixed assets/ turnover)	0.0851**		
	(0.0397)		
Constant	-1.0700***	0.2392	4.3395***
	(0.3646)	(0.5095)	(0.4718)
Rho	-0.5297***		
	(0. 1817)		
Sigma			0.8628***
			(0.0176)

Table 3: Average marginal effects. Two-way cluster adjusted standard errors in parentheses (by province and 2-digit Ateco codes)

	(1) Pr(I=1)	(2) Pr(D=1)	(3) Pr(D=1|I=1)	(4) Pr(D×I=1)	(5) Pr(L=100| D×I=1)	(6) E(lnL|L<100, D×I=1)
Not part of a group	-0.0089	0.0700***	0.0758***	0.0507***	-0.0065	-0.0057
	(0.0125)	(0.0248)	(0.0266)	(0.0187)	(0.0324)	(0.0286)
Age < 10 yrs	-0.0490***	0.0359	0.0251	-0.0092	0.0036	0.0032
	(0.0141)	(0.0265)	(0.0287)	(0.0219)	(0.0356)	(0.0316)
zscore_03	0.0069	-0.0054	-0.0039	0.0010	0.0143	0.0127
	(0.0073)	(0.0195)	(0.0231)	(0.0189)	(0.0209)	(0.0187)
Leverage03	0.1038*	0.3227***	0.3999***	0.3500***	0.1783*	0.1580*
	(0.0623)	(0.0920)	(0.1114)	(0.0947)	(0.0973)	(0.0873)
Ln(Turnover03)	0.0121	-0.0158*	-0.0141	-0.0035	-0.0786***	-0.0696***
	(0.0098)	(0.0085)	(0.0088)	(0.0079)	(0.0110)	(0.0099)
FixTotAss03	0.0545	-0.0182	-0.0032	0.0283	0.1361	0.1206
	(0.0836)	(0.1568)	(0.1747)	(0.1296)	(0.1560)	(0.1396)
ROA03	0.3968***	-0.0628	0.0552	0.2630***	-0.1066	-0.0945
	(0.1138)	(0.1330)	(0.1247)	(0.0822)	(0.2388)	(0.2124)
Listed	-0.0492	-0.0774	-0.1037*	-0.1032	0.1379	0.1222
	(0.0804)	(0.0609)	(0.0619)	(0.0646)	(0.1760)	(0.1564)
H local credit market	0.0380	-0.2244***	-0.2429***	-0.1558	-0.2935**	-0.2601**
	(0.1155)	(0.0694)	(0.0862)	(0.1051)	(0.1146)	(0.1011)
Local competitors only	-0.0691***	-0.0057	-0.0282	-0.0595***	0.0442***	0.0345**
	(0.000)	(0.0219)	(0.0227)	(0.0168)	(0.0163)	(0.0149)
ln(H local industry)	-0.0011	0.0078	0.0085	0.0058	-0.0199***	-0.0172***
	(0.0069)	(0.0097)	(0.0105)	(0.0082)	(0.0069)	(0.0063)
Ln(Reserves/Tot Assets)	-0.0035	0.0108**	0.0111**	0.0061		
	(0.0047)	(0.0044)	(0.0048)	(0.0046)		
ln(# employees)	0.0748***		0.0239**	0.0594***		
	(0.0140)		(0.0104)	(0.0130)		
ln(Fixed assets/ turnover)	0.0259**		0.0083	0.0206**		
	(0.0120)		(0.0057)	(0.0104)		
Global competitors * lnH					-0.0124	-0.0112
					(0.0087)	(0.0079)
Local competitors * lnH					-0.0472***	-0.0401***
					(0.0126)	(0.0116)