Competition and Inter-Firm Credit: Theory and Evidence from Firm-level Data in Indonesia*

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Abstract

Trade credit is one of the main sources of financing for firms in both developing and developed countries. This paper investigates the relationship between trade credit and suppliers' market structure. Using a novel firm-level dataset from Indonesia, we find that the amount of trade credit provided by suppliers increases sharply moving from monopoly to duopoly, more gradually when oligopolies are present before reaching a peak and declining steadily with higher competition. More importantly, we find strong evidence that the jump in trade credit from monopoly to duopoly is driven by the fact that monopolists are more likely to offer no trade credit to any of their clients. We provide a theoretical explanation for this anomaly by constructing a model in which a monopolist is unable to commit ex ante to the terms of trade credit. This lack of commitment results in a handicap in setting cash prices. In some case the monopolist is better off offering no trade credit. However, as competition increases trade credit becomes an important source of profit and this induces suppliers to increase credit provisions by a considerable amount.

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1 Introduction

Trade credit is arguably one of the principal sources of credit for firms in both developing and developed countries (Petersen and Rajan,1995; Rajan and Zingales, 1995). Trade credit is the credit that is extended by suppliers of a good to buyers every time a delay of payment is granted. Typically suppliers can set distinct prices for up-front cash payments and for delayed payments. In countries with underdeveloped formal credit markets the significance of trade credit is particularly high: firms acting as financial intermediaries play a fundamental role as bank substitutes extending credit to other firms rationed in the formal credit sector (Demirgüç-Kunt and Maksimovic, 2001; Fisman and Love, 2001). Although a sizeable literature has paid attention to the determinants of trade credit, very few studies have addressed the particular question of how supplier competition affects inter-firm credit. This paper investigates the issue at both a theoretical and an empirical level. Two are the main results. First, in the empirical analysis we find that monopolists are more likely to offer no credit to any of their clients than firms operating in more competitive markets; second in the theoretical model we demonstrate that, in some cases, trade credit can divert resources away from monopolists' core business inducing them to shut credit and accept only up-front cash payment; this does not apply to markets with more that one supplier. This results make a contribution to the literature of informal credit markets: we find that very often monopolists give up their role as informal creditor and show that this is likely to happen all the times credit is linked to another product or activity and some other conditions apply.

In the empirical analysis we use a novel firm-level dataset from Indonesia, which combines two existing datasets that contain information on the trade credit policies of a sample of manufacturing firms allowing us to retrieve the competitive environment in which they operate. The estimates show two striking results. First, a left skewed hump-shaped relationship between competition and trade credit provision. Indeed, the amount of trade credit provided by suppliers increases sharply from monopoly to duopoly and then more gradually in small-number oligopolies, before declining steadily thereafter. Second, we find that the bulk of the increase in trade credit from monopoly to duopoly is driven by the fact that monopolists are *more likely to provide no trade credit at all to their clients.* The results comfortably survive a number of robustness checks. While a traditional loan enforcement argument can explain the decreasing segment of the relationship between competition and trade credit provision, the increasing segment - particularly the "big jump" from monopoly to duopoly - appears to require a very different argument. The theoretical section of the paper sets out to achieve this.

In the model we provide an explanation of the "big jump" by showing that in some cases, monopolists fully shut down the trade credit window while duopolists never do so. To this end, we construct a model where suppliers can post a cash price for up-front payments but are unable to commit ex ante to the terms of trade credit. In monopolies this simple feature can be a major handicap in setting cash prices. We show this by demonstrating that after a cash price is posted and some buyers pay cash the monopolist may be tempted to loosen trade credit conditions to attract those buyers that cannot afford cash. The anticipation of trade credit will encourage buyers not to buy in cash, and divert resources away from the monopolist's core business. The monopolist can avoid this outcome, but only at the cost of substantially distorting the cash price that she posts. Under some circumstances, she is better off committing not to offer trade credit at all and accepting only up-front payment in cash.

The conditions on the parameters that affect the shutdown zone are interestingly related to the parameters of the model. In particular, if formal banks can adequately screen clients then the shutdown zone widens and the monopolist is more likely to offer no trade credit. But the same result is true if the monopolist is relatively efficient at providing trade credit: this will cause a greater distortion of her cash market and smaller revenues from that source, leading to a greater probability of shutdown.

In sharp contrast, when the model is extended to the case of two or more competitors we show that the lack of commitment becomes irrelevant. The reason is simple: Bertrand competition on the cash front drives cash margins extremely low, making the distortion of cash sales entirely unimportant. Thus suppliers are always willing to extend trade credit to their clients, provided that there are supplier-client specific costs in the provision of such credit. These costs prevent competition from driving trade credit price very low and make trade credit a substantial source of revenues for suppliers.

Indeed, within the same framework, we are able to explain why trade credit may continue to grow with the number of competitors, though not with the same intensity experienced in the change from monopoly to duopoly. This is driven by a more traditional competition effect: the entrance of a new competitor does not have much of an impact on the cash price that is already close to its minimum, while it leads to a decrease in the equilibrium trade credit price. In the overall market, therefore, the number of cash buyers does not increase while more buyers have access to trade credit. Hence the increase in the proportion of goods sold on credit.

The paper shows how the fundamental different nature between trade credit and cash can drive these results. In particular the fact that cash sales are spot transactions which entail no knowledge of the buyer and require no commitment, in that payments are made upon delivery of the good; trade credit, instead, involves a closer relationship between supplier and buyer and terms are effectively determined only after the good is delivered. This makes them very "stretchable" and closer to a "private deal" between supplier and buyer. This difference has two consequences in our model. First, it introduces for the monopolist a lack of commitment in setting the terms of trade credit that does not apply to cash price and, in some cases, forces her to shut down credit. Second, it makes competition on trade credit less strong than competition on cash and induces suppliers in more competitive markets to increasingly rely on trade credit as source of revenue.

Keeping loan enforcement problems out of the model we predict an increasing relationship between competition and trade credit. However, when the number of competitors increases loan enforcement constraints become increasingly serious. The possibility of deterring defaults by threatening to cut buyers out of future credit is less effective the higher is the number of alternative suppliers. Also the formation of *social norms* which prescribe that defaulters be boycotted by the entire market is less likely if the number of competitors gets higher. The estimation suggests that the enforcement constraints start biting with more than four, five competitors causing firms to reduce their trade credit thereafter.

The rest of the paper is organized as follows: Section 2 briefly explores the related literature, Section 3 presents a preview of the empirical results as motivation of the theoretical model contained in Section 4. Section 5 describes the dataset, while Section 6 lays out the empirical approach. In Section 7 the main results are presented followed by some robustness checks in section 8.

2 Related literature

Three strands of related literature are relevant to this paper. First, the literature on competition and formal credit provision. Second, the studies on trade credit. Third, the literature on durable goods in Industrial Organization.

The first literature on the banking credit provides conflicting conclusions about the relationship between creditors' market structure, access to credit and credit costs.

Some studies conjecture a *negative correlation between competition and credit* provision. Two sets of explanations are typically proposed. The first explanation is based on theories of the client-relationship, the second on a loan enforcement argument. A well established theory on information asymmetries and agency problems has argued that competition is likely to reduce incentives to establish long-term, cooperative relationships with the client which results in decreasing credit flows (Petersen and Rajan 1995; Marquez 2002). This is explained because, in competitive environments, creditors cannot expect to share the future surplus clients may generate. Similarly, studies on loan enforcement predicts a negative relationship between competition and credit provisions pointing to the monopolists' ability to enforce payment by threatening to cut off future credit (Ghosh, Mookherjee and Ray, 2000).

Conversely standard economic theory predicts a *positive effect of competition on credit* arguing that any deviation from perfect competition results in smaller loans to borrowers at a higher cost (see among others Guzman, 2000; Heffernan, 1996).

The second strand of literature focuses primarily on trade credit. A substantial number of studies has investigated both theoretically and empirically the determinants of trade credit, among others Cunat (2005), Burkart and Ellingsen (2004), Mian and Smith (1992), Biais and Gollier (1993), Petersen Rajan (1997). The interest for trade credit in developing countries has grown in recent years (World Bank 2004), given its important role as bank credit substitute and thanks to increasingly reliable firm-level datasets (Fafchamps 2000). Nevertheless very few studies, to our knowledge, address the issue of competition and inter-firm credit provision. Two papers to which our research is most related have examined the issue: namely McMillan and Woodruff 1999 and, Fisman and Raturi 2004. Using firm level datasets in Vietnam and Sub-Saharan Africa respectively they derive opposite results regarding how market power affects suppliers' credit conditions. The first uses a survey collected in Hanoi and Ho Chi Minh City and finds a negative correlation between the number of competitors operating within one kilometer of the firm and trade credit provided. The second uses a data from buyers to show that clients of monopolists have a significantly lower probability of receiving credit than firms that deal with more competitive suppliers. Our results are consistent with both the papers and in our opinion provide a possible reconciliation between the two.

We shall see that if we use a linear specification for the effect of competition on trade credit we also find a significant negative correlation but we show that a non-linear specification fits better the data. Our analysis suggests that Mcmillan and Woodruff's estimates may differ because of the limited cross section geographical variation of their data. Their survey covers only two urban and intensively industrialized districts with presumably highly competitive markets. Our survey, instead, covers all the major districts in Indonesia. Fisman and Raturi's dataset exploits a remarkable cross sectional variation with as many as five Sub-Saharan countries surveyed . Their results are in contrast with Mcmillan and Woodruff's but consistent with our finding of lower trade credit offered by monopolists. Our analysis, however, offers an important new insight on this issue. Using suppliers' data we can observe that the low probability of obtaining credit for monopolist's clients, found by Fisman and Raturi, is due to the high number of monopolists that shuts down credit to clients. This requires, in our opinion, a radically new explanation from what has been so far conjectured by this literature. Our theoretical model sets out to reach this goal.

The third set of related literature examines durable goods and the so called *Coase conjecture*. Coase (1972) was the first to notice that a monopolist of durable goods would have every incentive to cut the price of the good after a first group of buyers has purchased it in order to generate additional sales. Consumers, anticipating the price slashing behavior, would then choose to postpone purchasing the good when faced with static monopoly price. Rational consumer behavior would then force the monopolist to set the price close to the marginal cost. First Stokey (1979, 1981) and Bulow (1982) formalized and proved Coase's intuition studying both the case of full commitment and lack of commitment on the monopolist's side. In particular, in a infinite horizon model with no commitment Stokey finds an equilibrium in which the price path converges to marginal cost as the length of each period goes to zero. Gul, Sonnenschein and Wilson (1986) modelled the situation as an infinite-horizon game between a single firm and a continuum of consumers and discovered a continuum of additional subgame-perfect equilibria in this game. They proved that the subclass of weak Markov equilibria behave in the manner of Stokey's backward induction equilibrium.

Our model provides a very similar intuition on the consequence of lack of commitment in setting a trade credit price. Besides applying the durable good idea to trade credit, we introduce the idea that a no-credit policy can be used by a monopolist as a convenient commitment device and we characterize the circumstances under which this is optimal.

3 Summary of the empirical results

In this section we present a preview of the basic results of the empirical estimation that motivate the theoretical model.

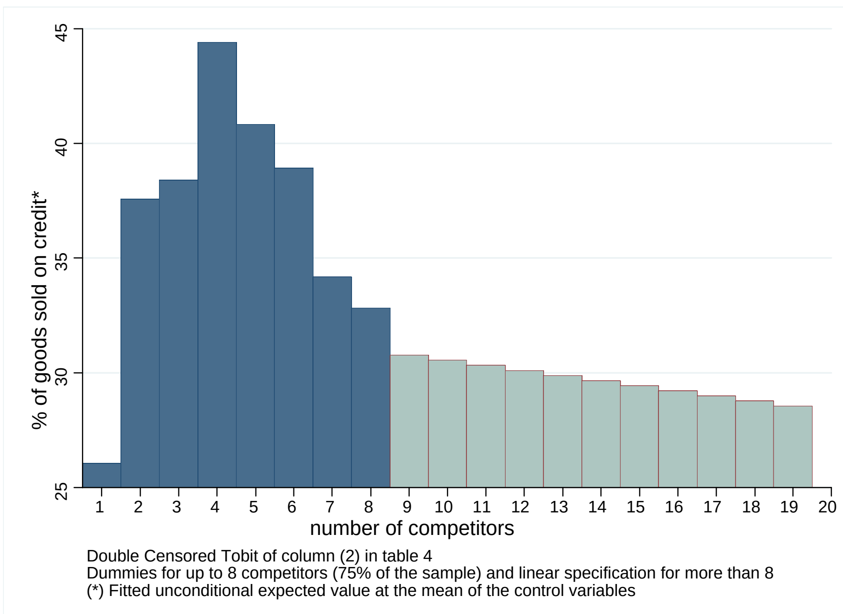


Figure 1: The effect of competition on trade credit

A thorough description of the dataset and details of the estimation and identification strategy are presented in section 5 and 6. Here we present some evidence on the relationship between competition and the amount of trade credit provided by suppliers.

The graph above depicts the estimated proportion of goods sold on credit in relationship with the number of competitors operating in a given area. At least three features of the estimation are striking. First, it is noticeable a sharp increase in trade credit provided to clients going from one to two competitors. The average proportion of goods sold on credit when two firms compete is 42 per cent higher than the same proportion when only one firm is active. Second, the trade credit granted increases gradually when a small number of firms compete reaching a peak at four competitors. Finally the percentage of goods sold on credit decreases steadily when more than four competitors are active.

The negative relationship between trade credit and competition is consistent with what found by McMillan and Woodruff (1999) and in line with what conjectured by the literature on loan enforcement in developing countries. This literature has argued that in economies with weak creditors' protection, where contracts have to be self enforcing, defaults are sought to be deterred mainly by the threat of cutting the borrower off from future access to credit. This threat is particularly strong if a creditor is a monopolist in a given market. Also with a small number of creditors, if information flows are significant, *social norms* which prescribe that defaulters be boycotted by the entire market, can give rise to positive levels of borrowing and lending (Ghosh, Mookherjee and Ray, 2000). As the number of lenders increases, however, the threat of reducing or cutting access to future credit is less effective since borrowers have a higher probability of finding an alternative source of financing and *social norms* are less likely to arise. Hence the higher presence of credit rationing in more competitive credit markets. This literature provides a particularly convincing interpretation of the negative relationship between competition and trade credit provision that arises in our data with more then four competitors.

The increasing part of the relationship, especially the discontinuous jump from one to two competitors, seems particularly striking. A closer investigation shows that, conditional on providing some positive trade credit, monopolists do not extend less credit than duopolists. What explains the jump is instead the fact that *suppliers with no competitors are more likely to provide no trade credit to their clients*. A probit estimate on the binary decision to sell some (1) or no product (0) on credit reveals that the probability of extending some trade credit increases by 17 percentage points from one to two competitors and remains basically unchanged for higher numbers or competitors (Table 5). We think that this finding is not adequately explained by a traditional argument provided by the literature that predicts a positive relationship between competition and credit provision. Instead of observing monopolists that provide a lower amount of credit at a higher price, we find that monopolists are more likely to offer no credit and sell all their products for cash only. This in spite of the fact that their enforcement power is much stronger than that of firms operating in more competitive settings. In the theoretical model we provide an explanation for this anomaly that intentionally abstracts from any enforcement problem.

4 The model

In this section the model is set up and the main results are derived. As we mentioned earlier, we construct a model which intentionally neglects enforcement constraints. The initial focus is on the case of one supplier to show under what condition it is optimal not to provide trade credit to clients. We then extend our analysis to the case of more than one supplier and show that it is never optimal to adopt a no-credit policy. This will imply a considerable increase in the proportion of goods sold on credit from monopoly to duopoly that we call the “big jump". Finally, we show that with more than one supplier the proportion of goods sold on credit increases with the entrance of a new supplier.

4.1 Monopoly

4.1.1 Set up

There is a single supplier of an intermediate good and a continuum of buyers with unit mass. The good is produced at no cost. Each buyer demands one unit of the intermediate good, transforms it at no cost and sells it at price P. This product price is privately known to the buyer but not to the supplier who knows only that the distribution of buyers types is given by some *cdf* $F(P)$. The supplier can either sell the intermediate good for cash or on credit. If the supplier provides the intermediate good on credit she will incur a monitoring cost m, to ensure that the delayed payment is eventually made.

We suppose that to finance the cash payment a buyer has to apply for a bank loan which she gets with an exogenous probability π. The supplier cannot distinguish buyers that actually applied for bank loans from those who did not, and must set the trade credit price based on her beliefs on the distribution of buyers who ask for trade credit.

The timing is as follows:

1. The supplier sets a cash price c;
2. The buyers decide whether to apply for a bank loan in order to pay cash or to wait and ask for trade credit;
3. Bank loan applications are accepted with probability π or rejected with probability $(1-\pi)$ by the bank. Cash payments are made. The remaining buyers are available to receive trade credit;
4. The supplier sets the trade credit price t;
5. Buyers decide whether or not to buy at this price;
6. Payoffs are realized.

The assumption that the trade credit price is set by the supplier only after buyers react to the cash price is critical to the model. This modelling device attempts to capture the idea that the supplier cannot post a trade credit price ex-ante. By its very nature, trade credit is a "private deal" between buyer and supplier. Credit terms are effectively determined after the cash price. To see this, notice first that the trade credit price should be interpreted more generally as trade credit terms, or overall price paid by a buyer that obtains credit. This also includes the delay of payment obtained.[1] Consequently, for instance, longer payment terms translate into a lower price. With this broader interpretation, we can look at some common trade credit practices as evidence of the inability of the supplier to determine ex-ante the terms of payment. It is indeed very common in both developed and developing countries that delays of payment turn out to be very different than what initially agreed. In a World Bank survey in 65 developing and transition economies, entrepreneurs report that almost half of the clients who receive trade credit settle their payment after the initial deadline. The time of the final payment reportedly varies among clients but takes place on average three or four weeks after the original deadline. Analogous evidence is found in Indonesia.[2] This suggests that once suppliers grant a delay of payment, she effectively postpones the moment in which the price is determined. Even in the absence of enforcement problems, once the payment delay is granted and the product is delivered to the client, the exact final trade credit price is determined only when the client pays. Put differently, the trade credit terms can be stretched after the product is exchanged.

In the model we introduce one possibility of commitment. This is to shut down the trade credit window altogether by publicly adopting a cash-only policy. This captures the idea that it is easier for the supplier to publicly commit to deliver the good only with an upfront payment rather than granting a payment delay and commit to pre-defined terms. As we shall see, under certain conditions, a monopolist supplier will use this commitment policy if it is available. Formally, we may model this possibility by adding a stage to the very beginning of the game described above: Stage 0, the supplier chooses whether or not to shut down the trade credit window.

4.1.2 Full commitment equilibrium and conditions for credit shut down

The main result of the model is contained in the next proposition where it is shown that there exists a threshold probability of obtaining bank credit such that for higher π the monopolist is better off shutting the "trade credit window" and accepting only up-front payments.

Proposition 1 *For any given monitoring cost, there exists a threshold probability of obtaining bank credit such that for any higher probability, the supplier will optimally decide not to offer credit and pre-commit to a "cash-only" policy. Furthermore, the threshold value is increasing in the monitoring cost.*

[1] Even if no interest rate is explicitly included, effectively the trade credit price should be seen as incorporating an implicit interest rate.

[2] World Bank's "Investment Climate Unit" Core Survey 2001 -2004.

A formal argument and proof of the result is provided in the appendix. Here we first provide an example that illustrates the main intuition of the result and then we describe the steps that lead to the main proposition.

The intuition of the main result is easily illustrated starting from the case where the supplier can *fully commit* to both cash and trade credit price and post them ex-ante. Notice that in this case she would never set the trade credit price below the cash price because, otherwise, this would induce all buyers to opt for trade credit which, given the monitoring cost, is less profitable than cash. Setting a trade credit price above the cash price instead induces all the buyers with a final product price higher than the cash price (henceforth "high price" types) to apply for bank credit. Among the buyers that are rejected by the bank, only those with a private price higher than the trade credit price buy the product on credit. All the other buyers with a final product price lower than the cash price (henceforth "low price" types) are simply left out of the market. In this scenario the supplier can effectively separate the maximization problems for the cash and the trade credit price. The optimal cash price, c^*, depends only on the distribution of types while the optimal trade credit price, t^*, depends on the distribution of types and the monitoring cost. Both of the optimal prices, under standard regularity condition on the profit function, are unique. The probability of obtaining bank credit then plays no role in the maximization problem of the supplier and trade credit is only extended to those buyers rationed in the formal credit sector.

Suppose now that the commitment power disappears and the supplier effectively sets the trade credit price only after observing the buyers' reaction to the cash price. In this case, the probability of obtaining bank credit and the monitoring cost start being critical. To see this, notice that nothing would really change compared to the full commitment case if, for instance, the monitoring cost was high enough, say higher than the optimal cash price c^*. In this case the trade credit price will anyway be higher than the cash price and therefore, again, all buyers would apply for credit to the bank and trade credit will be extended only to a subset of buyers rejected by the bank. Even if the monitoring cost were low, we could still have results identical to the "full commitment" case if the probability of obtaining bank credit were sufficiently low. In this case the distribution of buyers that apply for trade credit would have a large proportion of "high price" types rejected by the bank. The supplier would still find optimal to set a trade credit price above the cash price and the full commitment scenario would be replicated.

Let us suppose, instead, that the monitoring cost is low but the probability of obtaining bank credit increases considerably, say close to one. If all the high price buyers applied to the bank very few of them would be rejected. Consequently, the distribution of buyers who apply for trade credit would be almost completely made of "low price" types, i.e. with a private price lower than the cash price. The monopolist at this point would find optimal to set a trade credit price below the cash price thus selling the product to those buyers who could not afford to pay the cash price in the first place. This incentive would be anticipated by the buyers that would be attracted to trade credit. In turn, the "full commitment" equilibrium breaks.

Proposition 1, anticipates that if the probability π is *high enough* and the monitoring cost in *low enough* the supplier would be better off denying credit to her client and committing to a cash only policy. This, however, does not mean that when the *full commitment* equilibrium breaks the supplier decides to shut trade credit right away. She would first try to distort the cash price to convince some buyers to apply for a bank loan and pay cash. Only when all her attempts become too costly will she decide to commit to no credit.

To fully see the logic of the argument we will now take a step back, look first at the subgame starting at stage 4, where the supplier has to fix a trade credit price and proceed backwards to stage 1, where the supplier has to set a cash price to derive his optimal strategy for different values of the parameters.

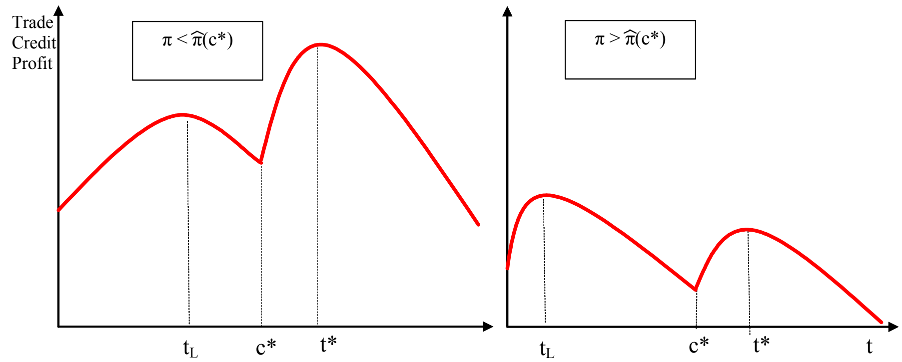
Stage 4: the supplier sets trade credit price

We examine here the optimal action of the supplier after she has already set the cash price and observed a number of buyers paying cash. She now observes buyers asking for trade credit. Let us look at the case in which the supplier believes that all high price types ($P > c$) applied for bank loan and low price types did not. We show in observation 1 that, in this case, there exists a threshold probability of obtaining bank credit $\widehat{\pi}$ such that for any π larger than $\widehat{\pi}$ the supplier will optimally set trade credit price below the cash price.

Observation 1 *: Assume that the supplier's belief is that all high price types applied to the bank while low price types did not. Then there exists a threshold value $\widehat{\pi}$, such that for higher probability of bank acceptance the optimal trade credit price is lower than the cash price; for lower π instead the optimal credit price is set above c. Furthermore, $\widehat{\pi}$ is a strictly decreasing function of the cash price c and strictly increasing in the monitoring cost m.*

Proof. see appendix. ■

In the diagram below we show the trade credit profit function of the supplier for the case in which the cash price was set at the "full commitment" level c^* and all the high price buyers apply to the bank. Noticeably for given values of π the profit has this double-hump shape.



On the left side it is depicted a situation when the probability of obtaining bank credit π is lower than the threshold value. Noticeably, in this case, also the trade credit price would be set at the full commitment level t^*. On the right side, instead, we have a case in which π is higher than the threshold value and the supplier will optimally set the trade credit price at t_L below the cash price, and the full commitment equilibrium cannot be attained. The maximum of the profit function for trade credit prices above the cash price is always reached at t^*, and this value does not vary with π.

The result stated in observation 1, that the threshold value of the bank loan acceptance probability is monotone increasing in c, implies that there exists a critical value that we call $\widehat{c}(m, \pi)$, such that for smaller cash prices the "left hump" is lower then the "right hump" and the supplier sets a trade credit price above the cash price. As we shall see in stage 2, this suggests that for any probability π larger than $\widehat{\pi}(c^*)$, the supplier could set a cash price equal or lower than the threshold $\widehat{c}$, thus inducing her "future self" at this stage to set the trade credit price above the cash price. How smaller this threshold value is than the full commitment optimal cash price c^*, depends on the parameters of the problem namely the monitoring cost, and the probability of obtaining the bank loan. If the cash price is set, instead, greater than or equal to the optimal "full commitment" trade credit price t^*, the threshold probability $\widehat{\pi}$ is zero.

The other conclusion contained in the observation, that $\widehat{\pi}$ is decreasing in m shows that the lower is the monitoring cost the higher is the incentive for the supplier to set a trade credit price lower than the cash price. Interestingly, this result is somewhat different from what the literature on informal credit markets and on trade credit has traditionally argued. This literature has put some emphasis on the fact that suppliers (or the informal creditors) can rely on a better knowledge of their clients or lower transaction costs in dealing with them than banks. Thanks to this advantageous position suppliers can bridge the gap between rationed borrowers and the formal credit sector. This result, on the other hand, shows that, if some commitment problem is present, this very same advantage can turn out to be detrimental for the supplier. The "closer" is the seller to the buyers the higher is the temptation to lower the trade credit price below the cash price. Put differently, the lower is the cost for the supplier to provide trade credit the more serious are the consequences of her lack of commitment. We will see later that this will increase the incentive to shut down the trade credit window.

Before we proceed with the analysis of the previous step, we should briefly look at the case in which no buyer applies to the bank. This would trivially lead to the same trade credit profit of the case of $\pi = 0$, which, under standard condition on the distribution of buyers types, would have a unique maximum in t^*.

Stage 2: buyers apply for bank's loan or ask directly for trade credit

Consider now a buyer who observes a cash price c. Her strategy can be defined as a probability of applying for bank loan and is a function of her type P, the probability of obtaining bank credit, the monitoring cost and of course the cash price. Now, it is clear that low price types will ask for trade credit regardless of the values of the parameters.[3] However, for high price types the decision does depend on the parameters. Buyers will have to anticipate what the supplier's trade credit price will be. If the cash price they observe is less than or equal to the threshold cash price $\widehat{c}$, it can be easily seen that in equilibrium they will apply for bank loan and the supplier will set the trade credit price at t^*. If they observe a $c \geq t^*$ they would believe that the trade credit price will not be larger than the cash price and therefore decide to ask for trade credit with probability one together with low price types.[4] The supplier will then actually charge a trade credit price equal to t^*.

The question remains open of what the equilibrium of the continuation game is if the cash price is strictly larger than $\widehat{c}$ but also strictly smaller than t^*. In this case we show that the buyers' strategy for which all high price types apply for a bank loan or ask for trade credit cannot be part of an equilibrium. We show in the lemma 4 in the appendix that if $c \in (\widehat{c}, t^*)$, no "identical strategy" for all high price types can be part of any equilibrium.

This leaves open the possibility that a strategy that is different among high price buyers can be part of the equilibrium. We define such a strategy a "type-contingent" strategy. More formally, a type-contingent strategy is one in which there exists a couple of distinct buyer types P_i and P_j, larger than c with a different probability of applying for a bank loan. With type-contingent strategies it must be the case that in equilibrium the trade credit price is equal to the cash price. If two high price buyers adopt distinct strategies it must be the case that they are indifferent between cash and trade credit and therefore they must believe t will be set equal to c.[5] Many equilibria with type contingent strategies exist, but it is easily seen that they are all pay-off equivalent for the supplier.

[3] For simplicity here we did not introduce the option for the buyer to withdraw without asking for trade credit. The model can easily be extended to incorporate this option. Also, in the presence of some small positive cost for the buyer to ask for trade credit it can be shown that the main results would still hold.

[4] In the appendix it is shown that for $c > t^*$ $\widehat{\pi} = 0$.

[5] This is proven in lemma 5 in the appendix. In lemma 6, also in the in the appendix, necessary and sufficient conditions are provided for type-contingent equilibrium strategies when $c \in (\widehat{c}, t^*)$.

An example of type-contingent equilibrium strategy is provided in the appendix as well.

In the following observation we summarize what we argued so far and characterize the equilibrium of the continuation game for any given value of c.

Observation 2 *the following strategies are an equilibrium of the continuation game starting at stage 3:*

$$\text{Buyers:}\begin{cases} \text{Low price types never apply for bank loan} & \text{for any } c \\ \text{High price types apply for a bank loan} & \text{if } c \leq \widehat{c} \\ \text{High price types do not apply for a bank loan} & \text{if } c \geq t^* \\ \text{High price types adopt a strategy } \sigma_m(P) & \text{if } c \in (\widehat{c}, t^*) \end{cases} \tag{1}$$

$$\text{The supplier sets a trade credit price} : t = \begin{cases} t^* \text{ if } c \geq t^* \text{ or } c \leq \widehat{c} \\ c \quad\quad \text{for } c \in (\widehat{c}, t^*) \end{cases} \tag{2}$$

Stage 1: supplier sets the cash price

Now we examine the decision of the supplier to set a cash price, given the equilibrium strategies above.

Naturally, if the value of π is lower than the threshold $\widehat{\pi}(c^*)$, the lack of commitment is not biting and we would have the "full commitment" equilibrium. If, instead, the probability of obtaining a bank loan is higher than the threshold $\widehat{\pi}(c^*)$, the supplier will face three alternatives. First, she can set $c \leq \widehat{c}$, so that the buyers can be sure that the trade credit price will be higher than the cash price and all high price types will apply for the bank loan. Under standard concavity conditions on the cash profit function it is evident that, in this case the cash price will be set exactly equal to the threshold $\widehat{c}$. Alternatively she can set $c \geq t^*$ thus inducing all the buyers' types to ask for trade credit. Finally, she can set $c \in (\widehat{c}, t^*)$, to which the high price buyers will respond with a type-contingent strategy $\sigma_m(P)$. It is shown in lemma 8 in the appendix that it is never optimal for the supplier to set a cash price $c \geq t^*$, thus selling to all buyer's types on trade credit. Whether in equilibrium the cash price is equal to the threshold value $\widehat{c}$ or to another $c \in (\widehat{c}, t^*)$ depends on the parameters and the distribution of buyers type. In any case we show that the equilibrium cash price will be different from the full commitment "unconstraint" optimal value c^*.[6]

Stage 0: open or shut the trade credit window

From the previous discussion it is clear that if the probability of obtaining bank credit is “high enough" the supplier has to distort the cash price away from its unconstrained optimal value c^* in order to induce some of the buyers to pay cash. Nevertheless, if π were just above $\widehat{\pi}(c^*)$ the distortion the supplier needed to make would not be very strong. She could lower the cash price to $\widehat{c}$ and still offer trade credit to her clients. Intuitively, the

[6] In lemma 9 in the appendix the equilibrium is more formally defined and proved.

higher π the more severe the cash price distortion will have to be and the lower the profits of the supplier. If π increases above a certain level, if a commitment device is available that allows the supplier to sell only on cash, she uses it. Hence the decision to shut down trade credit stated in proposition 1.

4.2 More than one supplier and the “big jump"

In this section we show that if two or more suppliers are operating it is never profitable to shut the trade credit window. If the suppliers differ in their transaction costs in dealing with the buyers, they will always find optimal to open the trade credit windows and use their closeness to their clients to soften the effect of competition. This leads to that considerable increase in the proportion of goods sold on credit from monopoly to duopoly that we call the “big jump". To illustrate this case we extend the model to introduce some heterogeneity among the suppliers on how "close" they are to different buyers. We do it by relaxing the assumption of one monitoring cost for all the buyers, and introducing supplier-buyer specific monitoring costs. This does not change the qualitative results we obtained for the monopoly case.[7]

Suppose there are N suppliers. If supplier provides the intermediate good on credit to a buyer she will incur a buyer-specific monitoring cost which is distributed according to a *cdf* $I(.)$. Put differently, every buyer i draws N *iid* monitoring costs, one for each supplier, from a *cdf* $I(.)$. Every supplier now sets a cash price c and a trade credit price t which is buyer-specific.[8] The rest of the model is identical to the monopoly case. The fact that the monitoring costs for the same buyer vary across suppliers reflects the presence of heterogeneous transaction costs in dealing with the client. For cash payments, instead, as in the monopoly case, no transaction cost is required and the cost of production (normalized to zero) is the same for all suppliers. This captures the idea that a buyer willing to pay cash perceives suppliers of an identical product as perfect substitutes and is likely to trigger a fierce competition among sellers.[9] If, instead, trade credit is sought, transaction costs enter into play and the buyer is likely to face different terms from different suppliers. This makes the nature of the competition on trade credit closer to that of a differentiated product, while the cash payment is closer to an homogeneous product.

We show in lemma 10 in the appendix, for the case of duopoly, that in this case the equilibrium involves a cash price equal to zero and a trade credit price strictly above zero. In the absence of capacity constraints and with homogenous products, competition will drive the cash price to zero in the fashion of a Bertrand competition. The trade credit

[7] The monopoly model can easily be extended to incorporate heterogenous monitoring costs. In this case we would have different threshold values of π that would induce the monoplist to shut the trade credit window. We will just have to find a rule to pick the right threshold $\overline{\pi}$.

[8] The cash price could also be buyer specific but we will see that the absence of heterogenous costs for the supplier in the cash segment will make the equilibrium cash prices unique for all buyers.

[9] The model could easily be extended to cover cases where the product is not identical. It might well be the case that there is also a level of differentiation in the underlying product or in its costs of production. However, as long as an the additional dimension of differentiation is brought about by trade credit provision and the related transaction costs, the results would be identical.

price, instead, will be strictly positive leading to positive profit margins.

With more than one supplier, then, it is evident that the commitment problem disappears, because the sharp decrease in cash prices deters any temptation to significantly lower trade credit prices below cash prices.

Here we provide an intuitive argument for the equilibrium trade credit prices. We could think of the monitoring cost as a measure of how close the supplier is to the buyer. For each supplier we can distinguish three sets of buyers. For supplier 1, for example, the first set corresponds to buyers that are too far from the competitors and for which the supplier can charge the optimal price $t^*(m_{1i})$. "Too far" in this case means that monitoring cost of the competitor is higher than the unconstrained optimal price $t^*(m_{1i})$. The second group consists of those buyers closer to supplier 1 but that are within reach of supplier 2. More formally those with $m_{1i} < m_{2i} < t^*(m_{1i})$. For this group supplier 1 will optimally set the trade credit price equal to the competitor's monitoring cost. Finally, for those buyers closer to supplier 2, the price is set to m_1.

The analysis so far indicates that with more than one competitor trade credit becomes the only source of profit for the suppliers. The drop in the cash price leads all buyers to apply for bank credit and commitment issues on the supplier's side are therefore no longer relevant. Trade credit is only extended to those buyers rejected by the bank.

What is instead the prediction of the model for the proportion of goods sold on credit conditional on providing some trade credit? Put differently, shall we expect that a monopolist who sells goods both on credit and for cash would increase or decrease the proportion of goods sold on credit in response to the entrance of a competitor? The answer to this question is more ambiguous. In the duopoly case, if we look at the set of buyers who are too far from the competitor, lemma 10 shows that their trade credit price is not different from the one set by a monopolist. Cash price, instead, declines considerably leading to an overall lower proportion of goods sold on credit. The results on the other buyers more exposed to competition is, however, less clear. Whether the proportion of them buying on credit over those paying cash increases depends on how much the trade credit price declines in relationship to the cash price. This ultimately depends on the distribution of monitoring costs.

Proposition 2 *With more then one supplier, an increase in the number of competitors leads to an increase in the proportion of good sold on credit by each one of them.*

Our final proposition states that when more than one supplier is operating, the proportion of goods sold on credit by each supplier increases with the number of suppliers. Intuitively the entrance of a new competitor will not affect neither the cash price nor the number of cash payers. Conversely the price of trade credit will necessarily decline. Every buyer has the option to buy from an additional supplier with a different monitoring cost. Intuitively the minimum of N+1 random monitoring costs is lower than the minimum of

N random variables. The decrease in trade credit price allows more buyers rejected by the bank to access trade credit.

5 The data

In the empirical analysis we combine a firm-level survey in Indonesia sponsored by the World Bank in 1998 and conducted by the *Budan Pusat Statistik* (BPS), the Central Bureau of Statistics, and annual data by the same BPS covering all manufacturing establishments in Indonesia with at least 20 employees. The fact that the two datasets have been collected by the same agency using therefore the same geographical and industrial classification codes, make them easy to be combined. In particular, both datasets contain detailed firm location codes and industrial sector codes (ISIC 2nd Rev) for the main good produced. For every firm included in the survey sample is therefore possible to retrieve a large set of information on the competitors operating in the same geographical area and use it to build measures of competition. We will come back to this in the identification strategy section.Let us now briefly illustrate the datasets.

The World Bank survey is part of a larger survey conducted in four East Asian countries in order to assess the effect of the Asian financial crises on the manufacturing sector and described in Hallward-Driemier (2000). Only in the Indonesian dataset is it contained the detailed location of the firm, essential for our analysis.

The Survey was conducted by the BPS with the help of the National Development Planning Agency (BAPPENAS) between November 1998 - February 1999. The original sample includes 955 manufacturing firms mainly from four manufacturing sectors, selected based on their importance to the economy in terms of value added, export orientation, and employment, as well as being representative of the manufacturing sector in Indonesia. The sectors are: food processing, textiles, chemicals and processed rubber, electronics and others. Individual firms were selected in a manner so as to have a sample that was a representative mix of firms of different size, location, ownership structure, and production orientation (domestic and export oriented).

In our main specification we use a restricted sample that is selected by excluding those firms which declare that their biggest competitor is abroad as well as those which export all their products. The sample size is therefore reduced to approximately 600 firms. The number varies in some specifications for missing observations. The sample distribution is as follows: food processing 35 percent, chemicals/rubber 25 percent, textiles 29 percent, electronics 8 percent, others 3 percent.

Small and medium firms, i.e. employing between 20 and 150 workers, account for about 65 percent of the sample. Large firms, defined as those firms employing more than 150 workers, account for about 35 percent of the sample. The sample is predominantly composed of non-exporters and single-establishement firms: 80 percent of the firms does not export and 90 percent exports less than 30 percent of their production while about

90 percent has only one establishment.

The survey contains both quantitative and qualitative information. The first includes balance sheet along with other production, financial structure and labor force data covering the period from 1996 to 1998. The second consists of responses provided by firms' owners or senior executives during interviews.

What makes the survey particularly suited for our purposes is a detailed section on trade credit that includes questions on the percentage of goods sold on credit, the days granted for the payment on average before the financial crisis (until July 1997) and after (Jul 97-Dec 98).[10] The questions suffer from the usual memory recall and measurement error bias that characterize this kind of surveys. The memory recall bias is likely to affect the change in the percentages and days reported for before and after the crisis especially if the effect of the crisis on trade credit is not of great magnitude. Since we are focusing only on the period before the financial crisis, however, the cross-section variation exploited for the identification of the parameters is less likely to be significantly affected by this kind of error. A potentially more relevant issue is the possible survival bias coming from the fact the only those firms active in the aftermath of the Asian financial crisis are included. In the robustness checks we use the information contained in the "census" BPS dataset before and after the crisis and show that the survival bias is not a concern in this case.

The census data by the BPS contains a complete enumeration of all manufacturing establishments in Indonesia with more than 20 employees and includes precise location codes, 4 digit classification (ISIC 2nd Rev.) of the main good produced and some detailed quantitative information such as short form income statements and balance sheets. No data on the firms' trade credit policies is contained in this survey. We use the BPS data to retrieve information on the competitive environment in which the firms in the World Bank Survey operate and derive a set of control variables.

Table 1 containing summary statistics of the data is included below.

`[insert table 1 here]`

6 Empirical approach

Our main goal is to accurately capture the functional form of the relation between competition and trade credit provision while controlling for unobserved heterogeneity potentially correlated with the level of competition.

The equation we want to estimate is the following partially linear model:

$$TC_{ips} = f(C_{ps}) + \eta' X_{ips} + \alpha' Z_s + \varepsilon_{ips} \tag{3}$$

[10] The Questionnaire asks also the average discount offered for early payments. The ambiguity of the question, which does not give room to identify the kind of discount offered, led only very few firms to answer, making the data uninformative.

where TC_{ips} is the proportion of goods sold on credit by firm i which produces product p in a given geographical area s. C_{ps} is a measure of competition in the production of good p in the same area. X_{ips} are firm level characteristics ; Z_s area characteristics.

In order to estimate equation 3, we will use different specifications of f to capture the possible nonlinearity of the effect of competition on trade credit.

The dependent variable of our estimates is a proportion with many observations at 0 and 100 per cent. To account for the nature of the dependent variable we will use a two-limit Tobit estimation. The maximum likelihood estimation, however, makes more difficult to deal with potential unobserved heterogeneity at the level of the industrial sector or sub-district. That is why we will also present results of OLS fixed effects estimation. We will first explain, in the next section, the measure of competition used in our estimates.

6.1 Measure of competition

The first step in the estimation of the effect of the level of competition on credit provision is to define a measure of competition in trade credit supply. We will use mainly the number of "competitors" in the sub-district (kecamatan) where the firm operates. For the analysis we define "competitors" those firms producing the same product as classified at four-digit ISIC level. The usual problems connected with the use of sector classification to measure competition apply here. The relevant market might include products classified in different sectors but perceived as substitute by the buyers. Our assumption is that on average the sector classification adequately captures products classification.

A crucial condition underlying the the use of a measure of competition linked to a specific geographical area is that markets for trade credit provision are mainly local. This requires that trade credit is more likely to be provided to clients who operate in the proximity of the supplier. This condition is immediately verified when the market for the underlying product is mainly local, but it does not necessarily require so. Especially in contexts where information and enforcement problems are significant, geographical vicinity makes information flows between the borrower and lender easier and often turns out to be crucial in mitigating obstacles to credit provision.

We shall see that the estimates show consistent evidence in favor of the "local trade credit market" hypothesis in that only local competition and the local characteristics of area help significantly explain trade credit provision. Furthermore, the characteristics of the Indonesian economy and of the firms in our sample and provide some clues that local markets are actually prominent.

First, the country's widespread island archipelago geography and generally poor transportation infrastructure is often quoted as a reason that makes local markets particularly significant in Indonesia (Blalock-Gertler, 2003). Second, we exclude from the sample those firms which declare that their biggest competitor is abroad as well as those who export all their products. The remaining firms are mainly medium-small single-establishment firms selling domestically.

The extension of the geographical area that covers the relevant market for trade credit provision has to take into account the characteristics of the data. The available data are organized in administrative units which include provinces (propinsi), districts (kabupaten) sub-districts (kecamatan) and villages (desa). The choice of sub districts as relevant area has been mainly driven by the empirical analysis on different geographical levels. We show, in the robustness checks section, that once we include the number of competitors in the sub-district, the number of competitors in the district, province or country have no explanatory power on the amount of trade credit granted to clients. This result suggests that "trade credit markets" area actually local. There are around 4,000 subdistricts in the country with an average of 20 villages each. In our sample we have 40 subdistricts, 25 districts and nine provinces.

The bare number of competitors is not necessarily the best measure of competition in general but it seems particularly suited for the problem at hand. When we examine the robustness of our results we also use the *market share* as alternative measure of competition and show that the qualitative results do not change. This measure, however, is affected by more serious problems of endogeneity due to a reverse causality between trade credit and market shares: sales as well as market shares are affected by the trade credit policies.

6.2 Functional form

We will use both a parametric and a semiparametric approach to estimate equation 3. A fully parametric estimate of equation 3 allows us to deal more effectively with issues of endogeneity or unobserved heterogeneity. A non parametric approach, on the other hand, seems particularly useful here to capture the "predicted" non monotonicity of $f(C_{ps})$ without making any assumption on it.

In the parametric estimates we use two specifications of $f(C_{ps})$. The first is a log quadratic specification

$$TC_{ips} = \alpha + \beta_1 Log(C_{ps}) + \beta_2 Log(C_{ps})^2 + \eta' X_{ips} + \alpha' Z_s + \varepsilon_{ips} \tag{4}$$

Where all the variables are the same as before. The log quadratic is better suited than the quadratic to capture an "asymmetric" non linear relationship between competition and trade credit.

We also estimate 3 with a linear spline specification with knots at $C_{ps} = C_{pc}^{j*}, j = 1, .., K$

$$TC_{ips} = \alpha + \beta_1 C_{ps} + \sum_{j=1}^{K} \beta_{j+1} I(C_{ps} \geq C_{ps}^{j*})(C_{ps} - C_{ps}^{j*}) + \eta' X_{ips} + \alpha' Z_s + \varepsilon_{ips} \tag{5}$$

where $I(C_{ps} \geq C_{ps}^{j*})$ is an indicator function that takes value 1 if C_{ps}^{j*} or more competitors are operating in the subdistrict and 0 otherwise. This is interacted with the number of competitors in excess of C_{ps}^{j*}. We choose the knots starting from the results of the log quadratic specification and test whether other knots increase our fit.

In the semiparametric approach we first approximate $f(C_{ps})$ with a step function. This leads to the following specification:

$$TC_{ips} = \alpha + \sum_{j=1}^{H} \beta_j I(C_{ps} = C_{ps}^{j*}) + \beta_{H+1} Log(C_{ps} I(C_{ps} > C_{ps}^{H*})) + \eta' X_{ips} + \alpha' Z_s + \varepsilon_{ips} \quad (6)$$

where $I(C_{ps} = C_{ps}^{j*})$ is a dummy for different numbers of competitors. For numbers of competitors greater than C_{ps}^{H*} we take the number of C_{ps}. The coefficients of the dummies β_j (plus the constant) can be interpreted as the mean trade credit provided in subdistricts with j competitors. We will run some hypothesis tests on the coefficients to test the shape of $f(C_{ps})$.

In our last specification we use a locally weighted linear regression to estimate $E(TC|C_{ps}, X_{ips}, Z_s)$[11]. Then we use the following weighted least square criterion:

$$\sum_{j=1}^{n} [TC_i - \beta(c_{ps}) - \eta' X_{ips}^{j} - \alpha' Z_s^{j}] K_{d_k}((C_{ps}^{j} - c_{ps})/d_k \quad (7)$$

Where j denotes the j^{th} observation, K_{d_k} is a non negative weight function and d_k is a bandwidth parameter. An estimator for $f(c_{ps})$ is then $\widehat{\beta}(c_{ps})$. As weight, we use a quartic kernel with "nearest neighborhood" selection of the bandwidth. A fixed bandwidth would do poorly given the characteristics of C_{ps} in our sample, with a high mass of observations around low values of C_{ps} and decreasing density as the number of competitors increases. Given the limited sample size and the fact that in (7) only local data are used, we cannot include a great number of control variables.

6.3 Identification strategy: unobserved heterogeneity

Our identification strategy relies on the ability of our cross-sectional estimates to control for potential sources of endogeneity. Two are most relevant here. Namely subdistrict level and firm specific unobserved heterogeneity correlated with competition. [12]

The possible correlation of those factors determining the location of firm with variables correlated to trade credit provision can be a serious problem that we have to deal with in

[11] See Fan (1992). The properties of this estimator are particularly well suited for our problem. In particular the consistency of the estimator even at the tails of the estimation is important in our data where the estimation at the tails are particualrly relevant.

[12] Also industrial sector heterogenity is relevant. It is well documented that trade credit varies substantially accross industrial sectors according to specific characteristics of the products or of the production process. We control for differences among products using three-digits ISIC sector dummies in all the specifications. In the robustness checks we also check possible interactions with the level of competition.

our identification. [13]

In particular, the decision of the firm to locate in a certain subdistrict might be influenced by some unobserved characteristics potentially correlated with credit supply. Urban or intensely populated areas, for example, may attract firms for the size of the market or the endowment of infrastructure but may also have more effective legal enforcement systems which could facilitate the provision of credit (Fisman-Raturi, 2004). This particular example suggests that this kind of heterogeneity might introduce a positive bias on the estimates of the coefficient of competition. Put differently, in areas with higher number of firms we should observe, all else equal, a higher amount of trade credit. Naturally other subdistricts specific characteristics might be at work which affect the coefficient in opposite directions.

We deal with this issue in a number of ways. In all the specifications we use district level dummies along with three-digit sector dummies. This is not enough because the variation in firms' location within a district could still introduce a bias. In the OLS estimates, included in our robustness checks, we include subdistrict fixed effects. This approach, however, is not viable in our Tobit estimation. The presence of unobserved heterogeneity potentially correlated with the explanatory variables is especially problematic in non-linear estimation given that fixed effects cannot be conditioned out in the estimates like typically done in linear fixed-effect models. Furthermore, the attempt to directly estimate ξ_s along with $f(C_{ps})$ might introduce an incidental parameter problem which could undermine the consistency of $f(C_{ps})$ (Greene 2004).

We cope with this issue in two ways: first, we estimate a random-effects Tobit model *a la* Chamberlain (1980) in which we allow for correlation between unobserved effects and competition. Second, when we restrict our attention to the binary decision of granting trade credit, we use a Logit subdistrict fixed-effects model.

As for the firm level heterogeneity we include a large set of firm level control variables capturing the financial situation of the firm, its size, its productivity shocks as well as the propensity to export.

The basic identification assumption is that, conditioning on our control variables at firm and subdistrict level, the variation in the number of competitors operating in each subdistrict is exogenous to trade credit and is enough to identify the effect of competition on trade credit provision.

[13] A direct "reverse causality" argument seems less relevant for our estimates. Although trade credit provision might be a non-negligible source of revenue, we believe that a vast majority of manufacturing firms decide where to locate their activity based on other factors than direct trade credit opportunities in the specific geographical area.

6.3.1 An unobserved-effect Tobit estimation

Consider equation 3 with a subdistrict fixed effect included[14]:

$$TC_{ips} = f(C_{ps}) + \eta' X_{ips} + \alpha' Z_s + \xi_s + \varepsilon_{ips}$$

Here the problem under analysis arises from the potential correlation between ξ_s and the explanatory variable C_{ps}.

Applying Chamberlain (1980) to our cluster sample case, we will assume a specific correlation between ξ_s and the explanatory variables. In particular we assume that

$$\xi_s | C_{ps}, X_{is} \sim Normal(\psi + \alpha \underline{C}_s + \varphi' \underline{X}_s, \sigma_a^2) \tag{8}$$

where $\underline{C}_s = \sum_{p=1}^{P} C_{ps}$ and $\underline{X}_s = \sum_{i=1}^{N} \sum_{p=1}^{P} X_{ps}$ and σ_a^2 is the variance of a_s in the equation $\xi_s = \psi + \alpha \underline{C}_s + \varphi' \underline{X}_s + a_s$. Basically, instead of including averages of the explanatory variables at cluster-subdistrct level we include the sum. In particular, $\underline{C}_s$is the overall number of manufacturing firms in the subdistrict and $\underline{X}_s$ includes variables like the overall value of production and fixed asset of all manufacturing firms in the subdistrict. This specification has the advantage of proxing some subdistrict characteristics that are likely to be correlated with the number of competitors in the district. [15]The total number of firms in the subdistrict, for instance, should help control for "location factors" that affect all manufacturing firms. If we further assume that

$$\varepsilon_{ips} | C_{ps}, X_{ips,} a_s \sim Normal(0, \sigma_\varepsilon^2) \tag{9}$$

$$a_s | C_{ps}, X_{ips} \sim Normal(0, \sigma_a^2) \tag{10}$$

we have the equivalent of a subdistrict random effect Tobit model with $\overline{C_s}$ and $\overline{X}_s$ as additional set of explanatory variable.

$$TC_{ips} = f(C_{ps}) + \eta' X_{ips} + \alpha \underline{C}_s + \varphi' \underline{X}_s + \alpha' Z_s + a_s + \psi + \varepsilon_{ips} \tag{11}$$

Equation 9 correspond to strict exogeneity assumption in a panel data context. The results of the random effect estimation are shown in the robustness checks section while the subdistrict level control variables are included in our main estimations.

[14]When the percentage of goods sold on credit is used as a measure of trade credit granted, TC_{ips},should be interpreted as the latent variable of a double censored Tobit model at 0 and 100. The observed TC_{ips}, therefore, will be: $TC_{ips} = \min\{100, \max(0, f(C_{ps}) + \eta' X_{ips} + \xi_s + \varepsilon_{ips})\}$

[15]This specification is equivalent to include a projection of ξ_s on C_{ps} and X_{ips}, $\widehat{\xi}_s = \psi + \alpha_1 C_{1s} + ... + \alpha_P C_{Ps} + \varphi_1 X_{1s} + ... + \varphi_P X_{Ps}$ and further assuming that $\alpha_1 = \alpha_2 = ... = \alpha_P$ and $\varphi_1 = \varphi_2 = ... = \varphi_P$.
In words we assume that, conditional on sectoral dummies and firm level characteristics, the unobserved characterisistics of the subdistrict affect similarly all manufacturing firms.

7 Results

Table 2 shows the results of the estimation of equation 4 estimated with a double censored Tobit. The marginal effects on the unconditional expected value of trade credit at the mean of the control variable are reported. In all the specifications, the coefficients for competition are individually and jointly significant at the one percent level. In the first specification, besides the log of the number of competitors and its square, we include three firm-level control variables; namely the percentage of goods exported, the log sales and the log value of fixed assets. In the second, in column (2), we include subdistrict level characteristics such as log total number of manufacturing firms and log total sales as well as the average percentage of goods exported in the subdistrict. Controlling for these subdistrict characteristics has the effect of reducing the coefficient of competition. In the same specification we also include a measure of the firms turnover in the subdistrict in 1996, namely the proportion of firms which started operating in the subdistrict in 1996 plus the proportion of those which exited in the same year.[16] This variable has a negative and significant impact on the amount of trade credit provided, signalling that suppliers are more wary to provide trade credit in those districts where the turnover of new and old firms is higher[17] . In the last specification in column (3), we include a set of additional firm level control variable including age, interest expenses on sales, percentage of capacity usage and change in the capacity usage from the previous year. The inclusion of this sets of control variable results in a marginal decrease of the coefficient of competition.

The proportion of good sold on trade credit reaches a maximum where around four competitors are active in the subdistrict and start declining for larger number of competitors. The standard error of the maximum is 0.6 which implies a 95% confidence interval of roughly [3,5].

We estimate equation 5 with a double censored Tobit and the same control variable as in column (3) in Table 2. We include a single knot at number of competitors equal 4.[18] The coefficient of $I(C_{ps} \geq 4)(C_{ps}-4)$ is negative and significant and confirms the change of the slope sign at the knot. The estimates, reported in column (1) table 3, indicate that each additional nearby competitor results in 3.5 percentage points increase in goods sold on credit up to four competitors. With more than four competing firms, the percent of goods sold on credit decrease smoothly with 0.33 percentage point decrease per competitor. As a check we show in column (2) of the same table, a restricted model which includes only the number of competitors and restricts the coefficient of $I(C_{ps} \geq 4)(C_{ps} - 4)$ to 0.

[16] The number of entries and exits is computed looking at the firms operating in the subdistricts at the end of 1995 and comparing them with those operating at the end of 1996.The firms included in the survey are those with more than 20 workers.Consequently some of the entries and exits might reflect an increase or decrease of the number of firm's workers above and below the survey threshold.

[17] If we break the turnover measure in its two components, proportions of new entries and exits, the coefficient of the two variables are both negative and significant.

[18] This is our best linear spline form. We also tested for the presence of additional and/or different knots, but the fit did not improved.

The coefficient on competition is negative and significant and suggests that any additional supplier increases the proportion of goods sold on credit by 0.3 percentage points. This last specification is analogous to the one run by Mcmillan-Woodruff (1999). They estimate a decrease of 0.7 percentage points for additional competitor, therefore twice as big as ours. The negative correlation between competition and trade credit estimated by Mcmillan-Woodruff (1999) can be driven by a prevalence of large numbers of competitors operating in the district. In particular, the fact that their dataset is limited to two largely populated and industrialized districts in Vietnam suggests that their sample possibly includes few firms that operate as monopolists. Our sample instead is representative of the whole manufacturing sector in Indonesia. Nevertheless, should we base our conclusions on this last specification we would support the authors' results that competition is harmful for trade credit provision. A LR test, instead, suggests that the unrestricted model with a change in the slope better fits the data.

Our next specification corresponds to equation 6. The equation is estimated including one dummy variable for each number of competitors from 1 to 8 and taking the log number of competitors for more than 8. Results using a double censored Tobit and the same control variable as in column (3) in Table 2, are depicted in figure 2 in the appendix together with the log quadratic fitted values. For an easier interpretation of the coefficients the estimates are reported in table 4 in a slightly different form. In place of the dummies for the number of competitors we report the coefficients of the dummies on whether the number of competitors is greater than or equal to two, three,...., eight. The coefficient on the first dummy, then, can be interpreted as the increase in the proportion of goods sold on credit going from monopoly to duopoly; the second dummy as the increase from two to three competitors, so on up to eight. The t-test on the coefficient is a test on the significance of each increase. A joint Wald test on the coefficients, instead, confirms the increase of the mean of trade credit with number of competitor up to four and then a decline. Interestingly, the most significant jump in the amount of credit provided is between monopoly and duopoly: the proportion of goods sold on credit by a duopolist is 42 percent higher than the same proportion for a duopolist (38 percent as opposed to 26 percent) while the increase for each competitor is smooth up to four and decline for more competitive settings.

In order to further investigate the determinants of this "big jump" we run a two-tiered model. The first tier is a Probit of whether the supplier grant 0 or some positive trade credit, and the second is a upper-censored Tobit of the proportion of goods sold on credit conditional on providing some trade credit. What explains the discontinuous increase in trade credit provided is the probability of offering some positive trade credit. The estimates, reported in column (2) of table 5, indicate that a duopolist has a probability of granting trade credit that is 17 percentage points larger than the same probability for monopolists. Conditional on providing some trade credit, instead, the estimates are more noisy also due to the reduced sample size. Duopolists seem to sell a lower proportion of goods on credit then monopolists, even if the estimates are not significant.

To further explore the issue in column (3) of table 3 we estimate a Logit model on the binary decision to grant trade credit including only a dummy variable for monopoly as measure of competition. This specification is similar to the one used by Fisman-Raturi (2004) and the results are consistent with theirs. Nevertheless, the analogy cannot be pushed too far. Fisman and Raturi look at buyer's data and find that the probability of obtaining credit is lower if the supplier is a monopolist. Their result, therefore, does not rule out a scenario in which monopolists offer lower trade credit to their clients. However, looking at data from the suppliers' side, we find something profoundly different and yet consistent with what they observed: suppliers with no competitors near them are more likely not to provide trade credit at all. Notice that if we were to use buyer's data our results would not be different from theirs.

Finally, the results of locally weighted regression are depicted in figure 3. This specification is the least demanding in terms of distributional assumption but suffers from the limited sample size. We therefore use the full sample and include as control variables the percentage of goods exported and fixed assets. The qualitative results are the same as those presented in the previous specifications.

8 Robustness Checks

Alternative measures of competition

In this section we show results of estimates that use different measures of competition.

We first use alternative geographical areas to assess the level of competition: we include in table 7 the number of competitors in the country, province, and district. Noticeably, once we control for the number of competitors in the subdistrict, the other variables do not have additional explanatory power. The result is confirmed by a likelihood ratio test. As a further check we also show the same estimates as in tables 2 and 4 using the number of competitors in the district in place of the subdistrict. The log quadratic specification still shows a hump shaped relationship between competition and trade credit but with a less sharp increase for low numbers of competitors. Not surprisingly, also the specification with the dummies in equation 6 shows a similar pattern, even if the estimates are more noisy.

Secondly we use market shares in the subdistrict as opposed to the number of competitors. This has the advantage of capturing possible differences in the relative "size" of competitors. The estimates, reported in table 8 confirm the non linear hump-shaped relationship between competition and trade credit provision. As an additional check we include the market share in the country, province and district and in specification (3) a dummy for market share equal one. The results are analogous to the one obtained using the number of competitors. Nevertheless, the potential endogeneity arising from the effect of trade credit on sales makes this specification more problematic.

Industry analysis

One concern is that we may be biasing our results by pooling across different industries with a wide variety of products and different competitive features: four competitors in electronics may have a very different impact than the same number of competitors in food processing. To explore this issue we run the estimations by industry. The estimates are reported in table 9. The qualitative results are the same as the pooled estimation, even if the reduced sample size makes the estimates less accurate and more noisy. We also report estimates excluding the "metal tools and structure" sector where the effect of competition on trade credit is particularly pronounced. The estimates are significant even if lower than the full sample ones.

Survival Bias

Another concern comes from the fact that the World Bank survey has been carried out in the aftermath of the Asian financial crisis among those firms that survived. If competition is correlated with the likelihood that a firm exit the market after the financial crisis our estimates might be biased. In particular, if monopolists and duopolists have experienced different mortality rates we could confound the differences in trade credit for the remaining sample with the inherent differences in the population. We address this issue using the BPS census data for before and after the financial crisis. We estimate a logit model to determine the effect of the competition in the subdistrict before the financial crisis on the probability of firms' death. After conditioning on firm size and the same set of control variables used in our main estimation we find that monopolists are not more likely to survive than duopolists or firms operating in more competitive settings. We conclude that the survival bias is not a concern.

Fixed effect estimates

Finally we address the issue of unobserved heterogeneity at subdistrict and product level, estimating fixed effect models. OLS estimates of equations 4 and 6 with subdistrict and 4 digit ISIC product fixed effects are reported in table X. Noticeably the estimates are very close to those obtained with Tobit. Furthermore, we estimate a random effect and fixed effect logit model on the binary decision to grant some positive or no trade credit. The logit is among the very few non-linear models that allow to difference out the fixed effect. As we mentioned, this option is not available in the Tobit estimates. The random effect estimates are very close to the fixed effect suggesting that our subdistrict level control variables do a good job in controlling for unobserved heterogeneity.

9 Conclusions

In this paper we have explored the relationship between trade credit and competition. In the empirical analysis we combined a World Bank Survey conducted in Indonesia with a comprehensive dataset from the Indonesian Central Bureau of Statistics (BPS) which contains a complete enumeration all Indonesian manufacturing firms with more than 20 workers. The use of the two datasets allowed us to combine data on the trade credit policy of a sample of firms with detailed information on the competitive environment in which each of them operate. The estimates revealed a left skewed hump-shaped relation between trade credit provision and competition. In our sample, the amount of trade credit provided by suppliers increases sharply going from monopoly to duopoly and more gradually moving to small-number oligopoly markets. After reaching a maximum at approximately four competitors, trade credit decreases steadily thereafter. We have argued that the decreasing part of the relationship is consistent with what found in previous studies and in line with what conjectured by the literature on loan enforcement in developing countries.

However, the increasing part and in particular the "big jump" from monopoly to duopoly is particularly striking. We have showed that the discontinuous increase is explained by the fact that monopolists are more likely to grant no trade credit at all to their clients. The result comfortably withstands a set of robustness checks also controlling for unobserved heterogeneity at the level of the market where the firms operate. We have pointed out that this result cannot be explained with traditional arguments provided by the literature that conjectures a positive relationship between competition and credit provision, but requires a radically different explanation.

To this end, we showed how a model in which suppliers are able to post cash prices but are unable to commit ex ante to the terms of trade credit can explain this anomaly. We argued that the lack of commitment is a natural consequence of the fundamental different nature between trade credit and cash. In particular, the fact that cash sales are spot transactions in which payments are made upon delivery of the good, while trade credit terms are effectively determined only after the good is delivered. This makes these latter very "stretchable" and closer to a "private deal" between supplier and buyer.

By simply allowing for some lack of commitment in setting trade credit price we have showed that, in some case, monopolists can be tempted to use trade credit as a tool for price discrimination and this possibility can seriously jeopardize their core business. This happens because borrowers in anticipation of favorable trade credit conditions decide not to pay cash, thus diverting resources away from monopolists' core business. In this case suppliers may prefer to protect their main activity by accepting only cash payment. In the theoretical model we have also demonstrated that this is more likely to happen if the market for "informal credit" is thin because the banks make relatively little credit rationing or if the supplier is particularly efficient in providing credit. Interestingly this latter point suggests that, if some problem of lack of commitment is present, the very same advantage that make suppliers ideal informal creditors can turn out to be detrimental to then and induce them to shut the credit.

This result makes a contribution to the literature on informal credit markets. This literature, in line with the studies in corporate finance, has pointed out that suppliers can leverage the relationship with their clients and act as informal creditors, extending credit to borrowers who are rationed in the formal sector. Most of the advantages of suppliers over banks, such as lower monitoring costs, easier liquidation of inventories in case of default or higher enforcement power given by lock-in effects, are strongest when the supplier is a monopolist.

Here we document empirically that monopolists often decide to give up their role as informal creditors and focus only on their core business. The theoretical explanation we provide can be extended to the many cases in developing countries where informal credit is interlinked to another activity. Our analysis suggests that with the growth of formal credit, many "interlinking" creditors, such as firms or rice traders, especially if not pressed by competition, may decide to abruptly give up their role as creditors and focus solely on their main activity. The access to credit by borrowers can in turn become even more difficult. This possibility may have serious implications for less developed countries or transition economies that are attempting to install formal credit markets or improving the existing ones. In line with what has been suggested by the literature on relational and formal contracts (Dixit, 2004) this result supports the idea that the process of gradual improvement of formal markets may inflict an interim cost to the economy, by worsening the outcomes of the currently used informal systems. Our results on small firms in Indonesia may be an example of what could happen in contexts where formal credit is starting to be increasingly more available.

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10 APPENDIX

Proof. of observation 1 . Let us focus on the subgame in which the supplier fixes t. For given c and m the suppliers will choose a t which maximizes the following profit function:

$$H(t) = \begin{cases} (t-m)[1-F(t)](1-\pi) & if\ t \geq c \\ (t-m)\{1-F(t)-\pi[1-F(c)]\} & if\ t \leq c \end{cases} \tag{12}$$

Define t_L the argmax of $H(t)$ for $t \leq c$, t_H the argmax of $H(t)$ for $t > c$, and $\widehat{t} = \max\{t_L, t_H\}$ i.e. the overall argmax of $H(t)$ .It can be noticed that $t_H = \max\{t^*, c\}$ where $t^* = \arg\max\{(t-m)[1-F(t)](1-\pi)\}$.Notice that t^* does not depend on π nor on c, while t_L is function of both. We aim to show that there exists a $\widehat{\pi}(m,c)$ such that $\forall\pi \leq \widehat{\pi}, \widehat{t} = t_H \geq c$ and $\forall\pi > \widehat{\pi}$, $\widehat{t} = t_L < c$. Put differently, defining:

$$\begin{aligned} Z(\pi) \quad = \quad & (t_H - m)[1-F(t_H)](1-\pi) - \\ & (t_L - m)\{1-F(t_L) - \pi[1-F(c)]\} \end{aligned}$$

$\forall\pi \leq \widehat{\pi}(m,c)$, $Z(\pi) > 0$.

Now noticeably $Z(0) > 0$, $Z(1) < 0$ and $Z(\pi)$ is continuous in π. We will show now that $Z(\pi)$ is a monotone decreasing function of π, to prove the existence of $\widehat{\pi}$ with a intermediate value theorem argument. To see this let us write the derivative:

$$\frac{\partial Z}{\partial \pi} = -\pi(t_H - m)[1-F(t_H)] + \pi(t_L - m)[1-F(c)] + \frac{\partial t_L}{\partial \pi}\frac{\partial Z}{\partial t_L}$$

We will now proceed showing that 1) the last term $\frac{\partial t_L}{\partial \pi}\frac{\partial Z}{\partial t_L}$ is zero and 2) $\pi(t_L - m)[1-F(c) < \pi(t_H - m)[1-F(t_H)]$, to show that the derivative is negative.

Let us define k the unconstrained argmax of $(t_L - m)\{1-F(t_L) - \pi[1-F(c)]$. To see 1) first notice that two cases may occur: $t_L \leq k$ or $t_L > k$. If $t_L \leq k$, clearly$\frac{\partial(t_L - m)\{1-F(t_L)-\pi[1-F(c)]}{\partial t_l} = \frac{\partial Z}{\partial t_L} = 0$ and therefore claim 1) follows trivially. If, instead , $t_L > k$, $\frac{\partial t_L}{\partial \pi} = 0$ and the the claim would follow as well.

To see 2) notice that for $\pi > 0$, $k < t^*$. Therefore if $t_H = c$, $t_L < t_H$ and 2) follows. If $t_H > c$ $t_L \leq c < t_H$ and 2) will be proven as well.

We conclude that there exists a $\widehat{\pi} \in (0,1) : Z(\widehat{\pi}) = 0$. and since $Z(\pi)$ is a monotone decreasing function of π, $\forall\pi > \widehat{\pi}$ $Z(\widehat{\pi}) < 0$.

Let us proceed showing that $\widehat{\pi}(m,c)$ is increasing with monitoring cost m. Let us look at $\frac{\partial Z(\widehat{\pi})}{\partial m} = [1-F(t_H)](1-\pi)] + \frac{\partial t_H}{\partial m}\frac{\partial Z}{\partial t_H} + \{1-F(t_L) - \pi[1-F(c)]\} + \frac{\partial t_L}{\partial m}\frac{\partial Z}{\partial t_L}$. $\frac{\partial t_H}{\partial m}\frac{\partial Z}{\partial t_H}$ and $\frac{\partial t_L}{\partial m}\frac{\partial Z}{\partial t_L}$ are zero. (see argument in the proof of proposition 1).Furthermore at $\pi = \widehat{\pi}$ it will have to be the case that $[1-F(t_H)](1-\pi)] < \{1-F(t_L) - \pi[1-F(c)]\}$. To see this look at Z and the fact that $Z(\widehat{\pi}) = 0$ and $(t_H - m) > (t_L - m)$. It is shown then that $\frac{\partial Z(\widehat{\pi})}{\partial m} > 0$ which together with $\frac{\partial Z}{\partial \pi} < 0$ implies that $\frac{\partial \widehat{\pi}}{\partial m} > 0$. To show that $\widehat{\pi}$ is decreasing in c, notice that $\frac{\partial Z(\pi)}{\partial c} < 0$. This together with $\frac{\partial Z}{\partial \pi} < 0$ shows the last part of the lemma. Finally if $c > t^*$ notice that instead $(t-m)\{1-F(t)-\pi[1-F(c)]\} > (t-m)[1-F(t)](1-\pi)$ $\forall t < c$. Therefore when $t_H = c$ $Z(\pi) < 0$ $\forall \pi$ and it follows that $\widehat{\pi} = 0$. ■

Lemma 3 *Let c be the cash price fixed by the supplier. Suppose that the supplier's belief is that the buyer applies for trade credit* $\forall P$. *Then the optimal trade credit price is* $t^* = \widehat{t}$.

Proof. omitted; ■

Lemma 4 *Let the* $\sigma(P, c, m)$ *denote the buyers strategy,defined as the probability of applying for bank loan, given the buyer's type* P*, the cash price, the probability of obtaining bank credit* π *and the monitoring cost* m*. Define a "pooling" strategy one in which for any distinct couple* P_i *and* P_j *strictly larger than* c*,* $\sigma(P_i) = \sigma(P_j)$*. If* $c \in (\widehat{c}, t^*)$ *no pooling strategy can be part of an equilibrium of the continuation game.*

Proof. Suppose a $P > c$ buyer observes $c \in (\widehat{c}, \widehat{t})$ and applies for the bank loan with probability 1. It must be the case that she anticipates that $t > c$. Suppose she is rejected and therefore asks for trade credit. In equilibrium the supplier should correctly believe that the $P > c$ buyer types applied for bank's loan and set a trade credit price $t^* = t_L^* < c$, as we showed in proposition 1. Consequently this cannot be a equilibrium. Alternatively assume that the buyer observes $c \in (\widehat{c}, \widehat{t})$ and ask for trade credit with probability 1. Again she must anticipate a $t < c$. In equilibrium the supplier should correctly believe that all the $P > c$ buyer types together with the asked directly for trade credit and set a trade credit price $t^* = \widehat{t} > c$, as we showed in lemma 3. Also this cannot be an equilibrium of the continuation game. The only case left is the case in which all the high price types adopt an identical strictly mixed strategy $\sigma(P)$. In this case they must anticipate that $t = c$. It is shown it what follows if all the high price types adopt an identical strictly mixed strategy $\sigma(P)$, the supplier will never find optimal to set $t = c$. The supplier's trade credit profit function at $t = c$ is $H(c) = (c-m)[1-F(c)](1-\pi\sigma(P))$. Now it can be easily seen that $H(c) < H(\widehat{t})$ since $\widehat{t} = \arg\max\{(c-m)[1-F(c)](1-\tau)\}$ for any value of t, and by assumption $H(t)$ has a unique maximum. ■

Lemma 5 *In any equilibrium with type-contingent strategies, the trade credit price must be equal to the cash price:* $t = c$.

Proof. of lemma 5. The lemma is easily proven for strictly mixed strategy. Consider instead that two high price types P_i and P_j adopt different pure strategies. Without loss of generality let $\sigma(P_i) = 0$ and $\sigma(P_j) = 1$ and suppose that $t > c$ in equilibrium. Call $Pr[\sigma(P_K)]$ the expected profit of buyer k conditional on his strategy. It can be easily seen that this cannot be an equilibrium because $Pr[\sigma(P_i) = 0] = (P_i - t) < (P_i - c)\pi + (P_i - t)(1-\pi) = Pr[\sigma(P_i) = 1]$. Analogously this cannot be an equilibrium for $t < c$. $Pr[\sigma(P_j) = 1] = (P_j - c)\pi + (P_j - t)(1-\pi) < (P_j - t) = Pr[\sigma(P_j) = 0]$. ■

Lemma 6 *A type-contingent strategy $\sigma(P)$is an equilibrium type contingent iff*

$$\sigma(c) = 0 \tag{13}$$

and

$$\pi \int_c^\infty \sigma(P) f(P) dP = [1 - F(c)] - f(c)(c - m) \tag{14}$$

Proof. of lemma 6. From the previous lemma we know that a necessary condition for any type-contingent equilibrium strategy is that $t = c$. We will show here that equations 13 and 14 are necessary and sufficient in order for the supplier to optimally set $t = c$. Consider the supplier profit function from trade credit

$$(t - m)[1 - F(t) - \pi \int_t^\infty \sigma(x) f(x) dx] \tag{15}$$

The demand for trade credit in square bracket can be seen as the mass of people with $P > t$ minus those who already obtained the bank loan. Recall that $\sigma(P) = 0$ for $\forall P < c$. The left derivative of 15 at $t = c$ is equal to

$$1 - F(c) - \pi \int_c^\infty \sigma(x) f(x) dx - f(c)(c - m) \tag{16}$$

the right derivative at the same point is instead

$$1 - F(c) - \pi \int_c^\infty \sigma(x) f(x) dx - f(c)(c - m) + \pi \sigma(c) f(c)(c - m) \tag{17}$$

Given that 15 is continuous and concave its max is at at $t = c$ only if $16 \geq 0$ and $17 \leq 0$. It can be easily seen that the these two conditions hold at the same time only weakly and if $\sigma(c) = 0$ so that $\pi \sigma(c) f(c)(c - m) = 0$ and if $\pi \int_c^\infty \sigma(x) f(x) dx = 1 - F(c) - f(c)(c - m)$.

■

Example 7 *Suppose $c \in (\widehat{c}, t^*]$. Let $\widetilde{t}$ be implicitly defined by the following condition $[1 - F(\widetilde{t})] = [\frac{(1-F(c)-f(c)(c-m)}{\pi}]$.Then the following strategies are part of an equilibrium of the continuation game:*

$$\begin{aligned} \textit{Buyer} \quad &: \quad \sigma_m(P) = \begin{cases} 1 \textit{ for } P \geq \widetilde{t} \\ 0 \textit{ for } P < \widetilde{t} \end{cases} \\ \textit{Supplier} \quad &: \quad t = c \end{aligned} \tag{18}$$

Proof. of example 7. We will show that if the buyer follows the above strategy the supplier will optimally set $t = c$, hence making the buyer indifferent between cash and trade credit. Consequently given that $t = c$ any deviation from the above strategy will not improve the buyer's payoff. Let us start with showing that $\widetilde{t}(\pi, c, m) > c$. To see this notice that $\widetilde{t}(\pi, c, m) > c$ iff $[1 - F(c)] > [1 - F(\widetilde{t})] = [\frac{(1-F(c)-f(c)(c-m)}{\pi}]$, which with some simplification can be written as $[1 - F(c)](1 - \pi) - f(c)(c - m) < 0$. It can be easily verified that this condition always applies if $\pi > \widehat{\pi}$.Furthermore notice that this condition also guarantees that $[1 - F(\widetilde{t})] = \frac{[1-F(c)]-f(c)(c-m)}{\pi} < [1 - F(c)] < 1$, i.e. that $\widetilde{t}$ exists.

The following is the supplier's trade credit profit function under the given buyer's strategy :

$$G(t) = \begin{cases} \{1 - F(t) - \pi[1 - F(\widetilde{t})]\}(t - m) \; for \; t \leq \widetilde{t} \\ [1 - F(t)](1 - \pi)(t - m) \qquad for \; t \geq \widetilde{t} \end{cases} \tag{19}$$

To see this notice that if $t \leq \widetilde{t}$ and the buyer adheres to the strategy under exam all the buyer's types with $P > t$ will ask for trade credit $(1-F(t))$ with the exception of those with $P > \widetilde{t}$ who obtain bank credit $(\pi[1 - F(\widetilde{t})])$. The demand $\{1 - F(t) - \pi[1 - F(\widetilde{t})]\}$ is then multiplied times the profit margin $(t - m)$. If instead $t \geq \widetilde{t}$ all buyer's types with $P > t$ will ask for trade credit, and for each of them the profit margin is always $(t - m)$. Hence the bottom line in 19.

Looking at the first derivative evaluated at $t = c$, and recalling that $c < \widetilde{t}$ we have that:

$$\frac{\partial G}{\partial t}(c) = [1 - F(c)] - \pi[1 - F(\widetilde{t})] - f(c)(c - m) \tag{20}$$

It can be easily verified by plugging our definition for $[1 - F(\widetilde{t})]$,that $\frac{\partial G}{\partial t}(c) = 0$. Furthermore under assumption the profit function is concave[19]. This shows that c is a max for the $t \leq \widetilde{t}$ region. To show that $t = c$ is actually a global max we will also need to show that $G(c) > G(t), \forall t > \widetilde{t}$. Now notice that for $\pi < 1$ and $t \geq \widetilde{t}$, $max\, G(t)$ is at $\max\{\widetilde{t}, t^*\}$ where t^* does not depend on π. Two cases may apply here. Either $\widetilde{t} \geq t^*$ or $\widetilde{t} < t^*$. In the first case, under the concavity of the profit function assumption, it is clear that $\frac{\partial G}{\partial t}(t) < 0$ for all $t > \widetilde{t} \geq t^*$. Together with the continuity of $G(t)$, this proves that $G(c)$ is a global max. Suppose instead that $\widetilde{t} < t^*$. From the same concavity argument,$\frac{\partial G}{\partial t}(t) > 0 \; \forall t \in [\, \widetilde{t}, \widehat{t})$ and $G(\widehat{t})$ is the $max\; G(t)$ for $t \geq \widetilde{t}$. To show that $G(c) > G(\widehat{t})$ we will start by showing that $H(t_L) > G(\widehat{t})$ where, recall, $H(t)$ is the supplier's profit function under the buyer's strategy that all types $P > c$ apply for the bank loan. t_L is the $\arg\max H(t)$ if $c > \widehat{c}(m, \pi)$ (i.e. $\pi > \widehat{\pi}$) and recall that $t_L < c$. Now notice that $G(t^*) = H(t^*)$, since $G(t) = H(t)$ for $t > \widetilde{t}$ and $t^* > \widetilde{t} > c$. It follows that $H(t_L) > H(t) = G(t)$. Furthermore it is clear by inspection that $G(t_L) = \{1-F(t_L)-\pi[1-F(\widetilde{t})]\}(t_L-m) > \{1-F(t_L)-\pi[1-F(c)]\}(t_L-m) = H(t_L)$. Finally $G(c) \geq G(t_L)$, because $t_L < \widetilde{t}$ and we showed that $G(c)$ is a max for $t \leq \widetilde{t}$.

In summary we showed that $G(c) \geq G(t_L) > H(t_L) \geq G(t^*)$. It follows that $t = c$ is the argmax of $G(t)$, $\forall t$ and therefore the supplier's best response to the buyer's strategy. If $t = c$ the buyer will be indifferent between cash and trade credit and any deviation

[19] Actually $(c - m)[1 - F(c)]$ is concave by assumption and consequently any $(c - m)[1 - F(c) + k]$

from 18 will not change her payoff $(P-c)$. ■

Lemma 8 *: define $G(c)$ the total profit of the supplier as a function of the cash price given the buyer's strategy in equation 1 and her own optimal response in equation 2. Furthermore let us define $\widetilde{c}$ the argmax $G(c)$ for $c \in (\widehat{c}, t^*]$[20]. Then $G(\widetilde{c}) > G(t^*)$.*

Proof. of lemma 8: for $\forall c \in (\widehat{c}, t^*)$ $G(c) = c\pi \int_c^\infty \sigma(P)f(P)dP + (c-m)[1-F(c) - \pi \int_c^\infty \sigma(P)f(P)dP]$ which by lemma 14 is equal to $G(c) = c[1-F(c)-f(c)(c-m)] + (c-m)[f(c)(c-m)]$ and after simplifications is equal to $(c-m)[1-F(c)]+mf(c)(c-m).G(\widetilde{c}) = \max\{(c-m)[1-F(c)]+mf(c)(c-m)\} \geq \max[(t-m)[1-F(t)] = G(t^*)$. ■

Lemma 9 *Define $G(c)$ the total profit of the supplier as a function of the cash price given the buyer's strategy in equation 1 and her own optimal response in equation 2.The equilibrium supplier's strategy is :*

$$c = c^*; t = t^* \qquad \textit{if } \widehat{c} \geq c^* \tag{21}$$

$$c = \widetilde{c};\ t = t^* \qquad \textit{if } \widehat{c} < c^* \textit{ and } G(\widehat{c}) < G(\widetilde{c}) \tag{22}$$

$$c = \widehat{c};\ t = t^* \qquad \textit{if } \widehat{c} < c^* \textit{ and } G(\widehat{c}) \geq G(\widetilde{c}) \tag{23}$$

Proof. The supplier's total profit function is :

$$G(c,t) = c\pi \int_0^\infty \sigma(P)f(P)dP + (t-m)[1-F(t) - \pi \int_0^\infty \sigma(P)f(P)dP]$$

which plugging the strategies in equations 1 and 2 and simplifying can be written as:

$$G(c) = \begin{cases} c\pi(1-F(c)) + (t^*-m)[1-F(t^*)](1-\pi) & \text{for } c \leq \widehat{c} \\ (c-m)(1-F(c)) + m\pi \int_c^\infty \sigma(P)f(P)dP & \text{for } c \in (\widehat{c}, t^*] \\ (t^*-m)[1-F(t^*)] & \text{for } c \geq t^* \end{cases} \tag{24}$$

To prove the optimality of equation 21 suppose that $\widehat{c} \geq c^*$.Then $\max G(c)$ for $c \leq \widehat{c}$ is $G(c^*) = c^*(1-F(c^*))\pi + (t^*-m)[1-F(t^*)](1-\pi)$ which is bigger than $(t^*-m)[1-F(t^*)]$ provided that $c^*(1-F(c^*)) > (t^*-m)[1-F(t^*)]$. We now need to show that $G(c^*) \geq G(\widetilde{c})$. To see this let us rewrite $G(c)$ for $c \in (\widehat{c}, t^*]$

$$c \int_c^\infty \pi\sigma(P)f(P)dP + (c-m) \int_c^\infty [1-\pi\sigma(P)]f(P)dP \tag{25}$$

[20] It can be easily shown that under standard conditions $\widetilde{c}$ exists.

(25) can be shown to be smaller than

$$c[1-F(c)]\pi + (c-m)[1-F(c)](1-\pi)$$

To see this notice that $[1-F(c)]\pi \geq \int_c^\infty \pi\sigma(P)f(P)dP$ and $[1-F(c)](1-\pi) \leq \int_c^\infty [1-\pi\sigma(P)]f(P)dP$ while $[1-F(c)]\pi+[1-F(c)](1-\pi) = \int_c^\infty \pi\sigma(P)f(P)dP + \int_c^\infty [1-\pi\sigma(P)]f(P)dP = [1-F(c)]$. intuitively a weakly positive mass of buyer's types switch to the less lucrative trade credit if $c \in (\widehat{c}, t^*]$ under the mixing strategy of the buyer *(show better !!)*. Finally since $G(c^*) \geq \widetilde{c}[1-F(\widetilde{c})]\pi + (\widetilde{c}-m)[1-F(\widetilde{c})](1-\pi)$ it follows that $G(c^*) \geq G(\widetilde{c})$.

To prove the optimality of (22) we first recall from proposition 8 that $G(\widetilde{c})$ is always bigger than $(t^*-m)[1-F(t^*)]$.

It can be easily verified that if standard concavity conditions apply to the cash and trade credit profit functions and $\widehat{c} < c^*$, then $\widehat{c}$ is the *argmax* $G(c)$ for $c \leq \widehat{c}$. Therefore If $G(\widetilde{c}) \geq G(\widehat{c})$ then $G(\widetilde{c}) = \max G(c)$. The optimality of (23) if $G(\widehat{c}) \geq G(\widetilde{c})$ follows easily.For $c \geq t^*$, $G(c)$ is constant. ■

Proof. of proposition1. We proceed showing the existence of two thresholds π_1 and π_2 so that $\forall\pi > \pi_1$ and $\forall\pi > \pi_2$, the profit from shutting the trade credit windows is respectively larger than the profit from setting $c = \widetilde{c}$ and $c = \widehat{c}$. We will then take $\overline{\pi}$ as the max of the two. We will first show that there exists $\pi_1 < 1 : G(c^*|\text{no credit}) = \pi c^*[1-F(c^*)] > \widetilde{c}[1-F(\widetilde{c})] - mf(\widetilde{c})(\widetilde{c}-m)] = G(\widetilde{c})$. $\pi_1 = \frac{\widetilde{c}[1-F(\widetilde{c})]-mf(\widetilde{c})(\widetilde{c}-m)]}{c^*[1-F(c^*)]} < 1$. To see this, define $V(\pi) = \widetilde{c}[1-F(\widetilde{c})] - mf(\widetilde{c})(\widetilde{c}-m)] - \pi c^*[1-F(c^*)]$. Notice that $V(1) < 0$ and $V(0) > 0$. Furthermore $V(\pi)$ is continuous and monotonic decreasing in π,$\frac{\partial V}{\partial \pi} < 0$ $\forall\pi$. The existence of π_1 follows from an intermediate value theorem argument. The fact that $\frac{\partial V}{\partial \pi} < 0$ can be seen immediately observing that $\frac{\partial G(\widetilde{c})}{\partial \pi} = 0$, since $\widetilde{c}$ does not depend on π given the type-contingent strategy of the buyer. More formally notice that $G(\widetilde{c})$ can be written as $\max\{(c-m)[1-F(c)] + m\pi \int_c^\infty \sigma(P)f(P)dP\}$ and that in a type contingent strategy, from lemma 6, $\pi \int_c^\infty \sigma(P)f(P)dP = [1-F(c) - f(c)(c-m)]$. $G(\widetilde{c})$ therefore can be written as $\max\{c[1-F(c)] - mf(c)(c-m)\}$. This implies that $\widetilde{c}$ does not depend on π and $\frac{\partial\pi \int_{\widetilde{c}}^\infty \sigma(P)f(P)dP}{\partial \pi} = 0$; consequently $\frac{\partial G(\widetilde{c})}{\partial \pi} = 0$.

Now we will have to show that there exists a π_2 such that $\forall\pi > \pi_2$ the total profit from shutting the trade credit window is larger than the profit from setting $c = \widehat{c}$. $G(c^*|\text{no credit}) = \pi c^*[1-F(c^*)] > \widehat{c}[1-F(\widehat{c})]\pi - (t^*-m)[1-F(t^*)](1-\pi) = G(\widehat{c})$. $\pi_2 = \frac{(t^*-m)[1-F(t^*)]}{c^*[1-F(c^*)] - \{\widehat{c}[1-F(\widehat{c})] - (t^*-m)[1-F(t^*)]\}} < 1$. Same argument as before. Notice that $\frac{\partial \widehat{c}}{\partial \pi} < 0$.[show better] ■

Lemma 10 *In equilibrium, with two suppliers, the cash price is* $c = 0$*, the suppliers' trade credit window is open, and the trade credit price set by supplier* $j = 1, 2$ *for buyer* i *is* $t_{ij} = \max\{m_{ij}, \min[m_{i,-j}, t^*_{ij}]\}$ *where* m_{ij} *is the monitoring cost for supplier* j *of buyer* i *and* $t^*_{ij} = \arg\max\{(t_{ij} - m_{ij})[1 - F(t_{ij})]\}$

Proof. (sketchy) To see that $t_{ij} = \max\{m_{ij}, \min[m_{i,-j}, t^*]\}$, consider, wlog the maximization problem of supplier 1 with respect to buyer i.

$$\begin{aligned} & \max_{t_{i1}} [(t_{i1} - m_{i1})[1 - F(t_{i1})](1 - \pi) \\ s.t.\ t_{i1} \quad \leq \quad & \max[m_{i2}, m_{i1}] \end{aligned}$$

■

the constraint comes from the fact that if $t_{i1} > m_{i2}$ supplier 2 will find optimal to under cut supplier 1 and get the buyer. Obviously if $m_{i2} < m_{i1}$ supplier 1 will set t_{i1} no larger that m_{i1}. t^*_{i1} is the unconstrained argmax.

The fact that in equilibrium the trade credit window is open follows trivially from the observation that the profit would otherwise be zero. $c = 0$ follows from a Betrand competition on c .

Table 1: Descriptive statistics

Variable	obs	Mean	Std. Dev.	Min	Max
% goods sold on credit	599	46	41	0	100
Number of days of payment delay granted to custome	595	28	31	0	180
Employment	599	321	582	17	1800
n. of competitors in the subdistrict	599	12	27	1	182
% good exported	599	10%	25%	0	99
Log(sales96 +1)	599	14	2	9	20
Log (book value of fix asset 96 +10)	599	10	6	0	21
firm age in 96, years	599	12	11	0	80
interest expense on sales 96	569	2%	6%	0	1
% capacity usage in 96	599	71%	26%	0	100
n. of firms in the subdistrict 96	599	92	111	1	398
Log (sales in the Subdistrict 96)	599	19	2	10	23
Average % of good exported in the subdistrict	599	11%	21%	0	99
% Production capacity usage in 96 in subdistrict	599	70%	20%	0	100
% firm turnover in the subdistrict in 96	599	11%	14%	0	100

Table 2: Tobit Percent of Goods Sold on Credit in early 1997

	(1)	(2)	(3)
Log (n. of competitors in the subdistrict 96)	13.919	12.400	13.295
	(3.62)***	(3.16)***	(3.26)***
Log (n. of competitors in the subdistrict 96)^2	-3.732	-3.710	-4.128
	(4.27)***	(4.25)***	(4.36)***
% good exported in 96	-0.153	-0.240	-0.217
	(2.05)**	(2.36)**	(2.08)**
Log(sales96 +1)	0.822	0.809	1.333
	(0.96)	(0.86)	(1.35)
Log (book value of fix asset 96 + 10)	0.566	0.587	0.612
	(1.87)*	(1.94)*	(1.91)*
Log (n. of firms in the subdistrict 96)		5.798	8.063
		(1.95)*	(2.62)***
Log (sales in the Subdistrict 96)		-2.426	-4.253
		(1.45)	(2.42)**
Average % of good exported in the subdistrict		0.187	0.171
		(1.48)	(1.32)
% firm turnover in the subdistrict in 96		-31.543	-27.936
		(2.33)**	(2.02)**
firm age in 96, years			-0.434
			(2.57)**
% Production capacity usage in 96			-0.069
			(0.65)
interest on sales 96			76.888
			(2.69)***
% Production capacity usage in 96 in subdistrict			-0.078
			(0.59)
Constant	24.245	50.362	97.016
	(0.93)	(1.63)	(2.92)***
Observations	598	598	568
Log Likelihood	-1710.83	-1705.11	-1640.15

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Marginal effects on the unconditional expected value of the dependent variable
three-digit ISIC sector dummies and district dummies included in all specificati

Table 3 : Percent of Goods Sold on Credit in early 1997

	Tobit	*Tobit*	*Logit*
	(1)	(2)	(3)
n. of competitors in the subdistrict 96	3.512	-0.308	
	(2.11)**	(3.60)***	
(n. of competitors in the subdistrict 96 - 4) I(n.comp<4)	-3.846		
	(2.29)**		
monopoly			-0.805
			(2.68)***
% good exported in 96	-0.210	-0.212	-0.004
	(2.00)**	(2.02)**	(0.57)
Log(sales96 +1)	1.299	1.148	0.008
	(1.32)	(1.17)	(0.11)
Log (book value of fix asset 96 +10)	0.621	0.598	0.047
	(1.94)*	(1.87)*	(2.14)**
Log (n. of firms in the subdistrict 96)	7.734	9.141	0.252
	(2.52)**	(3.04)***	(1.26)
Log (sales in the Subdistrict 96)	-3.586	-3.699	-0.109
	(2.07)**	(2.13)**	(0.91)
Average % of good exported in the subdistrict	0.162	0.188	0.002
	(1.25)	(1.46)	(0.26)
firm age in 96, years	-0.415	-0.425	-0.025
	(2.47)**	(2.53)**	(2.15)**
interest on sales 96	82.237	82.901	12.080
	(2.82)***	(2.81)***	(2.90)***
% Production capacity usage in 96 in subdistrict	-0.119	-0.113	-0.004
	(1.66)*	(1.57)	(0.82)
Constant	83.917	95.925	21.507
	(2.56)**	(2.96)***	(.)
Observations	568	568	499
	-	-	
Log Likelihood	1643.99	1646.63	-256.85

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

(1) (2) Marginal effects on the unconditional expected value of the dependent variable

three-digit ISIC sector dummies and district dummies included in all specificatiions

Table 4: Tobit Percent of Goods Sold on Credit in early 1997

	(1)	(2)	(3)
n. competitors in the subdistrict >=2	11.882	11.612	10.226
	(2.37)**	(2.30)**	(1.97)**
n. competitors in the subdistrict >=3	1.455	0.856	1.904
	(0.22)	(0.13)	(0.28)
n. competitors in the subdistrict >=4	4.824	4.215	3.325
	(0.65)	(0.56)	(0.44)
n. competitors in the subdistrict >=5	-3.185	-5.113	-3.366
	(0.34)	(0.55)	(0.35)
n. competitors in the subdistrict >=6	0.340	-0.873	-0.316
	(0.03)	(0.08)	(0.03)
n. competitors in the subdistrict >=7	-4.375	-4.559	-6.266
	(0.35)	(0.37)	(0.48)
n. competitors in the subdistrict >=8	-0.798	0.775	2.484
	(0.08)	(0.08)	(0.23)
(n. competitors in the subdistrict) I(Competitors >=9)	-0.192	-0.221	-0.272
	(2.50)**	(2.80)***	(3.04)***
% good exported in 96	-0.143	-0.229	-0.204
	(1.90)*	(2.21)**	(1.90)*
Log (sales96 +1)	0.938	0.925	1.384
	(1.06)	(0.96)	(1.36)
Log (book value of fix asset 96 + 10)	0.579	0.613	0.618
	(1.89)*	(2.00)**	(1.91)*
Log (n. of firms in the subdistrict 96)		6.183	8.173
		(2.06)**	(2.63)***
Log (sales in the Subdistrict 96)		-2.437	-4.276
		(1.44)	(2.40)**
Average % of good exported in the subdistrict		0.196	0.163
		(1.51)	(1.22)
% Production capacity usage in 96 in subdistrict		-0.136	-0.089
		(1.56)	(0.67)
% firm turnover in the subdistrict in 96		-30.098	-28.107
		(2.20)**	(2.01)**
interest on sales 96			77.042
			(2.69)***
% Production capacity usage in 96			-0.064
			(0.59)
firm age in 96, years			-0.424
			(2.49)**
Constant	25.653	64.395	98.991
	(0.97)	(2.00)**	(2.95)***
Observations	599	599	569
Log Likelihood	-1709.63	-1702.67	-1639.78

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Marginal effects on the unconditional expected value of the dependent variable

three-digit ISIC sector dummies and district dummies included in all specifications

Figure 2: Effect of competition on credit provision, dummies and log quadratic specifications

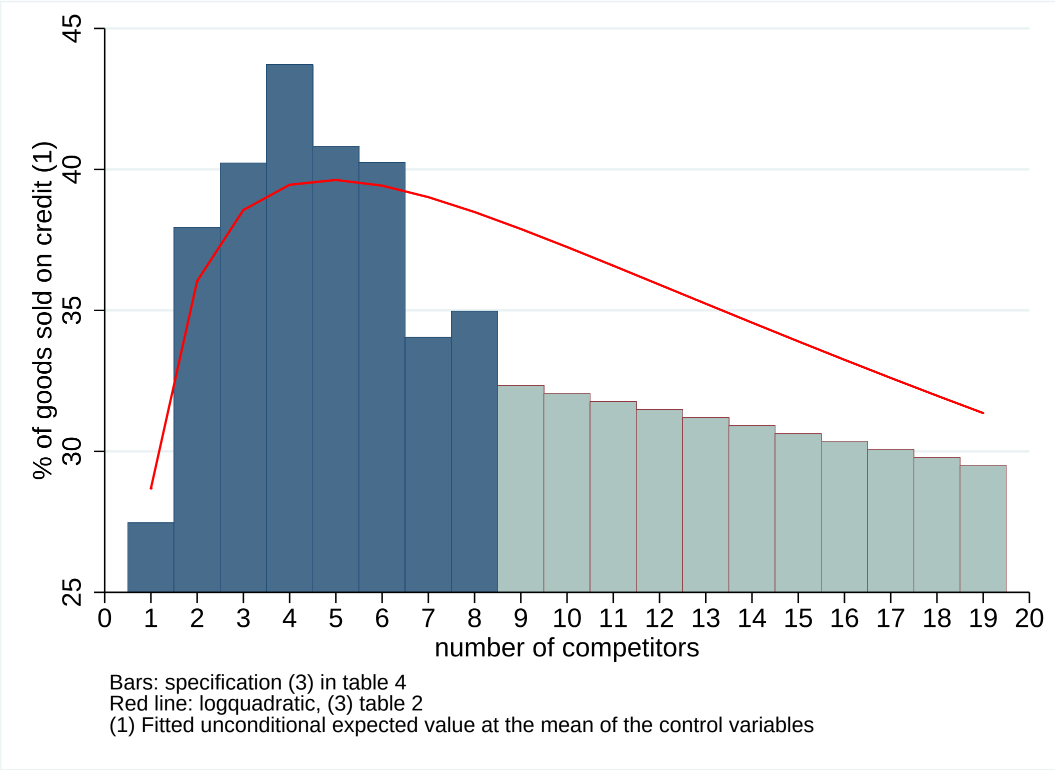

Table 5: Analysis of the "big jump"

	Tobit	*Probit*	*Tobit*
	(1)	(2)	(3)
n. competitors in the subdistrict >=2	10.696	0.171	-3.277
	(2.11)**	(2.12)**	(0.81)
n. competitors in the subdistrict >=3	0.785	0.022	1.084
	(0.12)	(0.21)	(0.22)
n. competitors in the subdistrict >=4	5.334	0.014	7.058
	(0.72)	(0.12)	(1.22)
n. competitors in the subdistrict >=5	-3.146	-0.053	-2.441
	(0.33)	(0.38)	(0.32)
n. competitors in the subdistrict >=6	-1.599	-0.091	3.502
	(0.14)	(0.53)	(0.38)
n. competitors in the subdistrict >=7	-4.363	0.083	-1.175
	(0.35)	(0.45)	(0.12)
n. competitors in the subdistrict >=8	-2.769	-0.041	-6.625
	(0.29)	(0.26)	(0.87)
(n. competitors in the subdistrict-9) I(Competitors >=9)	-0.228	-0.003	-0.051
	(2.85)***	(2.49)**	(0.79)
Log (n. of firms in the subdistrict 96)	3.637	0.057	-0.972
	(1.79)*	(1.99)**	(0.70)
Log(sales96 +1)	0.672	-0.004	1.398
	(0.75)	(0.29)	(1.91)*
Log (book value of fix asset 96 + 10)	0.567	0.011	-0.203
	(1.86)*	(2.47)**	(0.83)
% good exported in 96	-0.124	-0.001	-0.080
	(1.64)	(0.99)	(1.22)
Constant	22.029	5.933	27.901
	(0.84)	(5.35)***	(2.64)***
Observations	599	528	372
Log Likelihood	-1707.92	-281.31	-1358.93

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

(1) dependent variable: % goods sold on credit; Marginal effects on the unconditional Exp Value

(2) dependent variable: 1 if some goods are sold on TC is granted 0 o/w

(3) dependent variable % goods sold on credit if positive marginal effects

three-digit ISIC sector dummies and province dummies included in all specifications

Figure 3: Semi parametric locally weighted regression

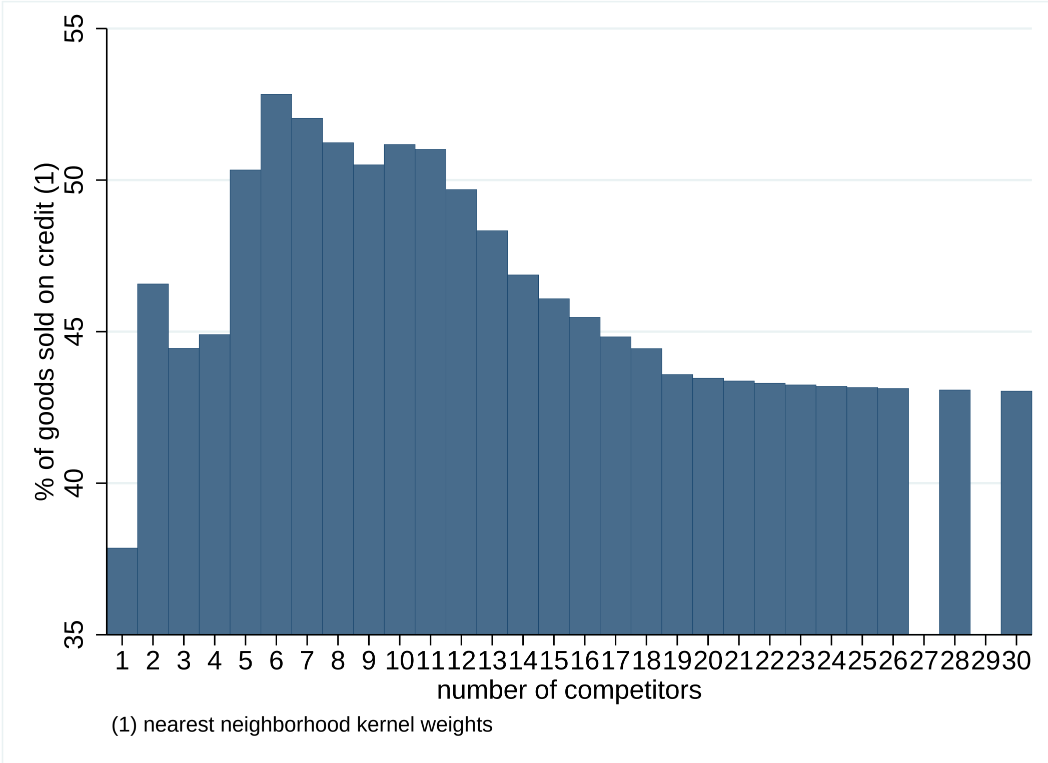

Table 7: Alternative geographic areas

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Log (n. of competitors in the country 96)	18.818	18.597	18.427	19.083	18.981	18.411	18.068	2.451	
	(1.13)	(1.12)	(1.11)	(1.15)	(1.14)	(1.24)	(1.22)	(1.06)	
Log (n. of competitors in the country 96)^2	-1.437	-1.430	-1.421	-1.489	-1.474	-1.420	-1.484		
	(0.91)	(0.91)	(0.90)	(0.95)	(0.94)	(1.02)	(1.07)		
Log (n. of competitors in the province 96)	-5.398	-5.141	-4.884	-3.093	-1.717	-1.228			
	(0.67)	(0.64)	(0.60)	(0.43)	(0.24)	(0.40)			
Log (n. of competitors in the province 96)^2	0.291	0.286	0.256	0.036	0.065				
	(0.30)	(0.30)	(0.27)	(0.04)	(0.08)				
Log (n. of competitors in the district 96)	5.703	5.576	5.460	2.961					
	(0.97)	(0.94)	(0.93)	(0.97)					
Log (n. of competitors in the district 96)^2	-0.522	-0.507	-0.470						
	(0.55)	(0.53)	(0.50)						
Log (n. of competitors in thevillage 96)	-3.787	2.739							
	(0.36)	(0.68)							
Log (n. of competitors in the village 96)^2	1.725								
	(0.66)								
Log (n. of competitors in the subdistrict 96)	11.285	9.946	10.435	11.192	12.970	12.942	12.711	12.934	13.919
	(2.19)**	(2.10)**	(2.24)**	(2.53)**	(3.23)***	(3.23)***	(3.21)***	(3.27)***	(3.62)***
Log (n. of competitors in the subdistrict 96)2	-3.647	-3.356	-3.179	-3.402	-3.540	-3.528	-3.534	-3.638	-3.732
	(3.21)***	(3.22)***	(3.15)***	(3.76)***	(3.95)***	(4.00)***	(4.00)***	(4.15)***	(4.27)***
% good exported in 96	-0.155	-0.159	-0.157	-0.157	-0.158	-0.158	-0.160	-0.156	-0.153
	(2.06)**	(2.11)**	(2.09)**	(2.09)**	(2.11)**	(2.12)**	(2.15)**	(2.09)**	(2.05)**
Log(sales96 +1)	0.826	0.862	0.837	0.858	0.870	0.867	0.858	0.874	0.822
	(0.96)	(1.00)	(0.97)	(1.00)	(1.01)	(1.01)	(1.00)	(1.02)	(0.96)
Log (book value of fix asset 96 + 10)	0.579	0.589	0.588	0.589	0.591	0.591	0.600	0.578	0.566
	(1.91)*	(1.94)*	(1.94)*	(1.94)*	(1.94)*	(1.95)*	(1.98)**	(1.91)*	(1.87)*
Constant	-24.428	-28.791	-26.537	-28.701	-31.536	-31.225	-29.192	9.651	24.245
	(0.51)	(0.60)	(0.56)	(0.60)	(0.66)	(0.66)	(0.62)	(0.33)	(0.93)
Observations	598	598	598	598	598	598	598	598	598
Log Likelihood	-1708.56	-1708.78	-1709.02	-1709.14	-1709.61	-1709.61	-1709.69	-1710.26	-1710.83

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

three-digit ISIC sector dummies and district dummies included in all specifications

Table 8: Estimates at district level

	(1)	(2)
Log (n. of competitors in the district 96)	10.287	
	(2.62)***	
Log (n. of competitors in the district 96)^2	-1.543	
	(2.35)**	
n. competitors in the district >=2		6.588
		(0.70)
n. competitors in the district >=3		11.392
		(1.30)
n. competitors in the district >=4		-11.617
		(1.11)
n. competitors in the district >=5		9.662
		(0.86)
n. competitors in the district >=6		-5.345
		(0.42)
n. competitors in the district >=7		-8.196
		(0.60)
n. competitors in the district >=8		15.522
		(1.57)
(n. competitors in the district) I(Competitors >=9)		-0.020
		(0.82)
% good exported in 96	-0.166	-0.164
	(2.11)**	(2.06)**
Log(sales96 +1)	2.032	1.991
	(2.26)**	(2.19)**
Log (book value of fix asset 96 + 10)	0.596	0.621
	(1.97)**	(2.03)**
Constant	-46.486	-48.436
	(3.15)***	(3.14)***
Observations	599	599
Log Likelihood	-1789.54	-1787.68

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

three-digit ISIC sector dummies and province dummies included in all specifications

Table 9 : Market Shares

	(1)	(2)
Market share in the subdisctrict	42.310	41.919
	(2.00)**	(1.98)**
Market share in the subdisctrict^2	-50.874	-45.492
	(2.59)***	(2.29)**
Market share in the district		-9.242
		(1.06)
Market share in the province		-5.932
		(0.36)
Market share in the country		-28.793
		(0.57)
% good exported in 96	-0.232	-0.237
	(2.22)**	(2.26)**
Log(sales96 +1)	0.677	1.228
	(0.64)	(1.12)
Log (book value of fix asset 96 + 10)	0.745	0.779
	(2.41)**	(2.51)**
Log (n. of firms in the subdistrict 96)	2.765	3.321
	(0.98)	(1.17)
Log (sales in the Subdistrict 96)	-1.034	-1.035
	(0.61)	(0.61)
Average % of good exported in the subdistrict	0.210	0.212
	(1.61)	(1.62)
Constant	49.438	41.346
	(1.60)	(1.32)
Observations	595	595
Log Likelihood	-1705.36	-1703.73

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 10: Industry Analysis

	All Sectors	w/o metal product and machines	Food	Textile	Chemical and Plastic products	Metal Product and Machines
	(1)	(2)	(3)	(4)	(5)	(6)
Log (n. of competitors in the subdistrict 96)	12.428	7.911	7.386	3.382	9.206	62.386
	(3.16)***	(2.02)**	(1.36)	(0.43)	(0.11)	(2.47)**
Log (n. of competitors in the subdistrict 96)2	-3.726	-3.057	-2.973	-2.070	-2.783	-17.087
	(4.27)***	(3.55)***	(1.29)	(1.45)	(0.78)	(2.04)**
Log(sales96 +1)	0.577	0.198	-0.788	2.584	1.244	1.229
	(0.67)	(0.23)	(0.96)	(1.39)	(0.71)	(0.37)
Log (book value of fix asset 96 + 10)	0.554	0.515	0.420	-0.651	-0.306	1.825
	(1.83)*	(1.70)*	(1.49)	(0.87)	(0.56)	(1.67)*
Log (n. of firms in the subdistrict 96)	3.421	3.641	3.858	-1.441	11.651	6.466
	(1.71)*	(1.86)*	(2.16)**	(0.35)	(3.23)***	(0.67)
% good exported in 96	-0.135	-0.135	-0.102	-0.062	0.004	-0.148
	(1.79)*	(1.85)*	(1.50)	(0.51)	(0.02)	(0.18)
Constant	20.718	30.098	11.457	17.522	-3.821	-139.187
	(0.79)	(1.19)	(0.52)	(0.58)	(0.11)	(1.82)*
Observations	598	549	209	154	186	49
Log Likelihood	-1709.36	-1581.48	-609.28	-404.93	-540.19	-115.86

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

three-digit ISIC sector dummies and district dummies included in all specifications except (6) where Province dummies have been used instead

Marginal effects on the unconditional expected value of the dependent variable

Table 11: Logit

	Sub-district Random	*Sub-district Fixed effect*
	(1)	(2)
Log (n. of competitors in the subdistrict 96)	0.753	0.821
	(3.00)***	(2.09)**
Log (n. of competitors in the subdistrict 96)^2	-0.219	-0.247
	(3.83)***	(2.55)**
% good exported in 96	-0.003	0.000
	(0.50)	(0.02)
Log (sales96 +1)	0.012	0.040
	(0.18)	(0.50)
Log (book value of fix asset 96 + 10)	0.047	0.021
	(2.30)**	(0.76)
Log (n. of firms in the subdistrict 96)	0.296	
	(1.48)	
Log (sales in the Subdistrict 96)	-0.034	
	(0.30)	
Average % of good exported in the subdistrict	-0.007	
	(0.82)	
% Production capacity usage in 96	-0.008	
	(1.32)	
Constant	18.604	
	(0.00)	
Observations	599	276
Log Likelihood	-292.66	-103.68
Number of provkabkec96	299	56

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Dependent variable: 1 if some trade credit is extended 0 o/w