

Trade Credit, Collateral, and Adverse Selection

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We show how trade credit use depends on the value of collateral in a repossession, as well as the extent to which firms face adverse selection problems when dealing with an outside investor. If a buyer defaults, then the seller is in a better position than is the investor to reclaim value from the repossessed good. Offsetting this is a concern on the part of the investor about the prudence of the seller's trade credit policy. In equilibrium sellers extend full trade credit to their *less* creditworthy buyers and partial trade credit to their *more* creditworthy buyers. The amount of credit extended to a more creditworthy buyer, is an increasing function of seller creditworthiness. Trade credit also induces a spillover from adverse selection in the financing, to the pricing and sales of goods. The results include the following. First, the theory explains why trade credit is short term credit. Second, the theory accounts for firms simultaneously taking and extending credit to other firms with similar levels of creditworthiness. Third, the conventional advice that firms should "collect early and pay late," is shown to be questionable general advice. Fourth, the theory explains why firms whose prospects start to deteriorate, often respond by increasing the extent to which they offer trade credit to their buyers.

1 Introduction

When one firm sells a product to another, the buying firm does not realize the revenues attributable to the purchase immediately. If the buyer is a retailer, this may reflect the time the good sits on a shelf prior to a final sale to a customer. If the buyer is a manufacturer, this may reflect the time the good sits in inventory, the time the good is being physically reprocessed, and the time it takes to deliver the good. To fill the gap in timing, requires financing. Investors could fund that gap by the provision of credit to the buyer, in which case the good is sold for cash. Alternatively investors could fund that gap by the provision of funds to the seller, who in turn extends trade credit to the buyer.

The central question in this paper is, under what circumstances will one approach or the other dominate? We show how the repossession rights to collateral and adverse selection, can account for much of what we know about the patterns of trade credit use.¹

The importance of repossession arises from the delay factor, and risks that arise during the delay. Because of these risks, the buyer may choose to default on the financing. In a default the creditor will be legally able to repossess the good. A repossessed good will be worth more in the hands of the original seller than in the hands of an investor. The original seller is in the business of selling such goods, the investor is not. This fact tends to support the use of trade credit. However, in order for the seller to be able to offer trade credit, the seller needs financing. This raises a problem. The investor does not directly observe the creditworthiness of the recipients of the seller's trade credit. Steps must be taken to ensure that the seller follows an appropriate trade credit policy. We refer to this as the relending problem.

As a result of the relending problem there is a trade-off, and so the provision of trade credit depends on the creditworthiness of the seller. When considering sales that are expected to be profitable, the seller extends full trade credit to the less creditworthy buyer. The seller will extend partial trade credit to a more creditworthy buyer. The more creditworthy the seller,

¹The order of magnitude of trade credit use can be seen through various comparisons. Petersen and Rajan (1997) make the point that the payables are commonly larger than bank debt. Rajan and Zingales (1995) show that trade credit represented 17.8% of total assets for American firms in 1991; while in many other countries such as Germany, France and Italy, trade credit represented more than a quarter of total corporate assets. According to Lee and Stowe (1993), "...there was approximately \$683 billion in trade credit outstanding by the end of 1985. This sum exceeded the volume of financial media such as corporate bonds and state and local securities; it was almost seven times the volume of consumer credit outstanding, and far exceeded the business lending of the entire banking system."

the greater the proportion of trade credit that will be provided to a more creditworthy buyer. The buyer obtains the balance of the required funds directly from the investor. The reason that the less creditworthy buyer receives more trade credit is that such a firm is more likely to default. It is in a default that the advantage of the seller over the investor in handling repossessed goods, is the most critical.

The importance of adverse selection arises from the fact that trade credit is not separable from other aspects of company finance. The terms on which firms can raise funds from the investors make the use of trade credit look more or less profitable. If offering trade credit looks too expensive to a seller, he may lower the price charged on a cash sale, in an effort to maintain the level of sales. Exactly how this works depends on why it is that outside financing is too expensive. Following Myers and Majluf (1984), we assume that corporate insiders are better able to assess the value of the assets in place than can the outsiders, even when the investor deals directly with the buyer. This creates an adverse selection issue, and so conditions the terms on which firms can raise funding.

We model a situation in which there is some degree of adverse selection on both sides of the market. In the production of low cost goods², the seller offers to sell either, for cash or on trade credit. An overvalued buyer pays cash and an undervalued buyer takes the trade credit. However for moderate cost goods, an undervalued seller will not offer trade credit; choosing instead to cut the cash price he would otherwise charge, in order to attract an undervalued buyer. The overvalued seller is willing to sell either for cash or for credit. An overvalued buyer pays cash and an undervalued buyer takes the trade credit. If the production cost is sufficiently high, then an undervalued seller only posts a cash price, but an undervalued buyer is unwilling to pay cash. They fail to reach a mutually beneficial deal. An overvalued seller is willing to sell either for cash or to offer trade credit.

There are four aspects of the analysis to be stressed. First, it is often claimed that firms match the maturities of their assets and liabilities (see Diamond (1991) for a theory). This could provide a different basis for the fact that trade credit is short term credit, than we provide. However the importance of collateral does a better job of explaining at least some observations. For instance, the collateral approach helps explain why empirically there is no

²To be precise, it is the seller's cost relative to the buyer's final revenue which matters. We normalize the buyer's revenue to be one.

relation between cash holdings (short term asset), and accounts payable (short term liability).

Second, existing theory does not easily account for firms with similar creditworthiness both offering credit to, and taking credit from each other. Under the approach taken in this paper, such behavior is to be expected. Beyond that, we find that very creditworthy firms extend more trade credit and take less trade credit, than do average firms.

Third, many practitioners and textbooks recommend that firms should collect their receivables rapidly, and stretch their payables.³ In support of this recommendation, it is commonly pointed out that firms behaving in this manner seem to outperform apparently similar firms doing the reverse. Or else it is pointed out, that firms make the recommended change at the same time as their profits improve. The assumption is that causality is from the credit policy to profitability. In our theory undervalued firms will commonly extend less than an average amount of trade credit, take more than an average amount of trade credit, and charge lower than average prices. However this is reflective of undervaluation, not causal of profits. Of course ex post, previously undervalued firms will appear to have outperformed apparently similar firms who were not undervalued. The recommended imitation of such policies, by firms who are not undervalued, could be a costly mistake.

Fourth, it has been observed that when the prospects of a fast growing firm take a turn for the worse, sometime the managers respond by extending more credit to their customers; in an apparent attempt to maintain sales. In our analysis this could be the correct profit maximizing action by the manager. When the firm's prospects take a turn for the worse, raising funds to finance more credit, now seems cheaper than before. Once the investor realizes the change in the firm's true prospects, the firm will cease being overvalued. At that point the surge in trade credit use will be cut back.

The paper is organized as follows. The rest of the introduction discusses the related literature, and the applicable American legal context. In section (2) the loss of control experienced by the investor in relending is analyzed. In section (3) there is adverse selection in the assets of both the sellers and the buyers. Thus for some firms extending trade credit is cheap, while

³Brigham and Houston (1998) present Core Industries as worthy of emulation. The firm is said to have improved its working capital management by reducing receivables, and taking trade credit which they describe as "essentially free." According to Ross, Westerfield, and Jaffe (1996), "After the optimal amount of liquidity is determined, the firm must establish procedures so that cash is collected and disbursed as efficiently as possible. This usually reduces to the dictum, 'collect early and pay late'."

for others it seems expensive. We show how this affects the use of trade credit as well as the pricing of goods sold for cash. The main empirical implications of the analysis are collected in (4). Section (5) concludes.

1.1 Related Literature

The literature on trade credit can be divided into papers that focus on the real operations and papers that focus on the financial aspects. Real operations motivations for trade credit include, transaction cost minimization, price discrimination, and quality guarantees. The existing theories show effects that may be important in specific circumstances, but they do not capture what seems to be central for explaining the wide spread use of trade credit and the empirical patterns of its use. This shows up in several ways. Partly it shows up in the specialized nature of the assumptions required in previous papers such as the credit rationing, quality guarantee, and price discrimination theories. In each case the suggested effects could happen. In each case the circumstances required are somewhat specialized. Partly it shows up in counterfactual empirical implications.

If trade credit existed to minimize transactions costs as in Ferris (1981), then we should have observed a long term decline in trade credit use, due to the many improvements in transactions technologies that have taken place. Such a long term decline has not occurred. Hence there must be more to the use of trade credit.

According to Brennan, Maksimovic and Zechner (1988) firms use credit to provide discriminatory price reductions to less wealthy customers. Their analysis is restricted to imperfectly competitive industries. Some firms may be better able to hold inventory, and as in Emery (1987) trade credit may be used to induce them to hold it.

Trade credit may play a role when there is uncertainty about whether the seller is providing a high quality product. This idea has been studied by Lee and Stowe (1993), Long, Malitz and Ravid (1993), Emery and Nayar (1994), and Deloof and Jegers (1995). The idea is that until the buyer can verify the quality of the good, he does not pay. The delay in payment is implicitly a guarantee of the quality of the good. Such guarantees are likely to be of particular importance for smaller and less well established sellers.

An early financial approach to trade credit was to suggest that it reflects arbitrage. Emery (1984) argues that when the borrowing and lending rates that are available to firms differ,

trade credit can serve to arbitrage the difference. A related idea is that trade credit may serve to mitigate credit rationing. According to Smith (1987) the seller learns the state of the buyer from the fact that it took the expensive trade credit. The seller then offers financial assistance to a troubled buyer in order to protect his investment in their long term relationship. According to Biais and Gollier (1997) the seller's provision of trade credit provides a valuable signal to the investor that a buyer is worthy of credit, and so the investor provides the buyer with more funding than he would otherwise have provided.

Since essentially all firms both offer and receive trade credit, the credit rationing theories seem to suggest that all firms are credit rationed, which is not usually claimed. Or else they must leave to some other theory, the observation by Petersen and Rajan (1997), that large firms both offer and receive more trade credit than do small firms.

There are a number of other studies that are related to our paper in various ways. Petersen and Rajan (1997) is an important study of the empirical patterns of trade credit use. Thakor (1995) provides an overview of financial intermediation and the market for credit. Particularly helpful reviews of the institutional environment are provided by Cole (1992), Parkinson and Kallberg (1993), and Hill and Sartoris (1995). Mian and Smith (1992) focus on alternative institutions such as the use of captive finance companies. Smith and Schnucker (1994) study the factoring decision.

1.2 Legal Context⁴

The value of a seller's claim depends in part, on his rights in the event that the buyer defaults. These rights fall into two categories. First, the rights that the seller has with respect to the buyer. Second, the rights that the seller has with respect to third parties who may also have claims to the buyer's assets. These third parties may include banks which have made loans to the buyer, the buyer's customers who have purchased the good, and if the buyer becomes bankrupt, the trustee in bankruptcy.

In the United States trade credit was originally a matter handled by Common Law. Since 1951 it has been covered by the often amended, Uniform Commercial Code (henceforth UCC) except in Louisiana.⁵

⁴For those interested in more detail than we provide, see Hanson and Schenkel (1995) and Garvin (1996).

⁵Louisiana has a legal system that is based in civil law, and they have not adopted the UCC. In Louisiana the manufacturer reclaiming his good, has priority.

In principle the seller has the right to reclaim the good delivered on credit to an insolvent buyer.⁶ This right is general for ten days, and stronger if within the last three months, the buyer has misrepresented his solvency in writing. In order to reclaim the good, it must still exist. For example, once cattle has been cut into steaks or coal has been converted into coke, then they cannot be reclaimed by the seller.

Once the good is reclaimed, the original seller will normally sell the repossessed good. If, as is usually the case, this secondary sale is for less than the seller is owed, then the balance of the amount owing goes into the pool of unsecured claims against the bankrupt buyer. Such unsecured claims are usually lucky to get even a few pennies on the dollar. If, adjusting for costs of carrying out the resale, the secondary sale is for more than the amount owed, then surplus goes towards the other claims against the bankrupt firm. If the reclaiming seller chooses to keep the repossessed good, then there may be subsequent legal disputes over the fair market value of the good.

There may also be other claimants to the good. The good cannot be reclaimed from a customer who purchased it in good faith from the buyer. The courts have interpreted “purchased” rather broadly, to include cases in which a buyer has granted a floating lien to his banker or other suppliers of funds. A floating lien is a secured interest in after-acquired property. Floating liens are quite a common device.

To get priority above a floating lien, the UCC allows the seller needs to register what is known as a “purchase money security interest” (henceforth a PMSI). A PMSI is essentially similar to registering a mortgage against a particular good. A properly registered PMSI grants the seller the top priority.⁷

⁶[Para. 2702] Sec. 2-702. Seller’s Remedies on Discovery of Buyer’s Insolvency

(1) Where the seller discovers the buyer to be insolvent he may refuse delivery except for cash including payment for all goods theretofore delivered under the contract, and stop delivery under this Article (Section 2-705).

(2) Where the seller discovers that the buyer has received goods on credit while insolvent he may reclaim the goods upon demand made within ten days after the receipt, but if misrepresentation of solvency has been made to the particular seller in writing within three months before delivery the ten day limitation does not apply. Except as provided in this subsection the seller may not base a right to reclaim goods on the buyer’s fraudulent or innocent misrepresentation of solvency or of intent to pay.

(3) The seller’s right to reclaim under subsection (2) is subject to the rights of a buyer in ordinary course or other good faith purchaser under this Article (Section 2-403). Successful reclamation of goods excludes all other remedies with respect to them.” UCC Rep Serv, Code @ 2-702.

⁷As explained in a legal textbook: “A PMSI [Purchase Money Security Interest] provides protection for the seller in the following situation, although a perfected security interest already exists in the collateral: First State Bank advances funds to Jones Manufacturing and perfects a security interest in all the firm’s equipment. The

The UCC does not make it equally easy to register such a claim for all categories of goods. For equipment, under UCC section 9-312(4) (of the 1995 version), as long as the PMSI is recorded within ten days, then the seller of the equipment has priority over the floating lien. In 42 states, 20 days are permitted for registration. Goods that will form part of buyer inventory can also be covered by a PMSI according to UCC 9-312(3)b. In this case in order for the seller to have priority over a creditor holding a floating lien, requires that the prior creditors receive immediate notice. No grace period is permitted.⁸

Hanson and Schenkel (1995) provide a synopsis of the UCC, intended to help credit managers. They stress the importance of setting up office procedures to ensure that these statements are routinely filed without mistakes. Such registration costs any where from \$3 to \$25 depending on the state. The review by Garvin (1996) provides much more detail about the legal structures than we have provided, as well as giving references to relevant legal cases.

The central point for the theory is that, by registering a PMSI the seller can have top priority to reclaiming a good sold on trade credit. The law makes it easier to protect that right for equipment than for goods sold for inventory.

2 The Relending Problem

In this section we analyze the interaction between two considerations. On the one hand a firm that normally sells a particular good is better positioned than is an investor to get full value from that good, if it is repossessed from a defaulting buyer. On the other hand if the investor funds the transaction indirectly by offering financing to the seller rather than to the buyer, the investor does not directly observe the financial worthiness of the buying firms that are being offered trade credit. The equilibrium shows how these effects interact.

2.1 The Model Structure

There is a seller, a buyer, and a perfectly competitive investor. All parties are risk neutral and the time value of money is zero. As a result the investor prices all securities at their expected

security agreement contains a provision extending the bank's interest to any after-acquired equipment. At a later date Jones purchases a new machine on credit from Smith Machine Company. As long as Smith Machine files a financing statement within ten days of the machine's delivery, its security interest has priority over that of First State Bank." Dunfee, Gibson, Blackburn, Whitman, McCarty and Brennan (1984) pages 570-571.

⁸It is worth mentioning that leased goods do not change title, and accordingly the holder of a floating lien does not normally have a claim to a leased good.

payoff. The seller has monopoly power and one unit of the good to sell. The seller is solvent with probability s , where $0 < s < 1$.

The investor does not know for sure how risky the recipient of trade credit is. The simplest way to allow for that within a model is to have two kinds of buyers, a high type that will be solvent with probability b_h , and a low type who is solvent with probability b_l , where $0 < b_l < b_h < 1$. The high and low buyer types are equally likely to arise. It is assumed that this particular deal is not marginal, and so the solvency of the buyer is independent of the terms of this deal. It is also assumed that production costs are sufficiently low relative to the value of a sale, that in each event it will be profitable to produce.

At time t_0 the seller observes the buyer's type and decides the price and terms to offer to the buyer.⁹ At t_1 the buyer observes the price and terms offered. He either accepts these terms or else he rejects them. If he accepts the offer then one or both of the firms will ask the investor for funding. At t_2 the investor accepts all funding requests that at least allow the investor to break even. Other requests are rejected. The terms of the loan are as follows: the borrower promises to repay 1 dollar at time t_4 and in return the investor loans him L at time t_3 . Depending on the equilibrium, the borrower could be either a seller or a buyer. If a deal has been reached, then at t_3 the seller produces the good at a cash cost of c . The good is transferred to the buyer. The investor observes the type of any firm being funded directly. The investor does not observe the type of a buyer receiving trade credit. At t_4 all uncertain states have their true values revealed. Then cash is settled according to the manner in which the agreements interact with the actual state.

The value of the good to a solvent buyer is normalized to be 1. If the buyer defaults on a trade credit financed deal, then the seller can repossess the good, and will realize a value of δ , where $0 < \delta < 1$. The investor is less well positioned to obtain value from a repossessed good. For algebraic simplicity it is assumed that in a repossession, the investor gets zero. We assume that from the perspective of the investor the transaction is secured. Thus if the seller defaults and the buyer does not default, then a loan from the investor to the seller gets repaid by the buyer.

How much will a buyer be willing to promise to pay? If he is solvent then he just breaks

⁹We model the seller as having the bargaining power. Similar results will obtain if the buyer has some bargaining power.

even if he promises to pay \$1. If he is insolvent, then he will not regret any promises since his payoff is zero. Accordingly both types of buyer will promise to pay \$1, to whoever finances the deal. That can be a promise to the investor, or a promise to the seller on trade credit. The buyer will never promise more than \$1 since that could only pay if some of the value is coming from being overvalued by the investor. However the investor knows the type of any firm that is being directly funded.

If the investor lends to a buyer, then the investor observes the buyer's type. In exchange for the promised repayment of a dollar, a high type buyer will receive a bank loan of $L_{bh} = b_h$. A low type buyer will receive a loan of $L_{bl} = b_l$. If the buyers are borrowing directly from the investor to fund the transaction, then the goods market sale is a cash sale.

If the investor lends to the seller, then the seller extends credit to the buyer. The investor observes the creditworthiness of the seller, but does not observe the creditworthiness of the buyer. How much the investor will lend to the seller depends on the investor's belief about the credit policy of the seller. If the investor thinks that the seller is lending to a low type buyer, then the investor will lend $L_{sl} = s + (1 - s)b_l$ to the seller. The interpretation of this expression is simple. If the seller is solvent the investor will get the dollar repayment, and the probability of that is s . If the seller is insolvent then there is still a chance of repayment in the event that the buyer is solvent. If the seller defaults, but the buyer does not, then the lender is still repaid. The chance of this is $(1 - s)b_l$. By the same reasoning the investor will lend $L_{sh} = s + (1 - s)b_h$ if the investor thinks that the seller is extending trade credit to a high type buyer. If the investor thinks that it is equally likely that the seller is funding either type of buyer, then the investor will lend $L_{sp} = s + (1 - s)(b_h + b_l)/2$ to the seller.

Since the seller has the bargaining power, any money loaned by the investor to a buyer, will be demanded as the sale price when the good is being sold for cash. The seller's payoff when selling to a type i buyer for cash is

$$\pi_i^{ca} = b_i - c, \quad i = h, l. \quad (1)$$

When selling on trade credit the seller's payoff is denoted π_{ij} where i is the actual buyer type which may be high (h) or low (l). The buyer type expected by the investor is denoted as j , and it may be high (h), low (l), or pooled (p). The seller's expected payoff is

$$\pi_{ij} = L_{sj} - c + s(b_i + (1 - b_i)\delta - 1). \quad (2)$$

Initially the seller gets L_{sj} from the investor, and spends c on production. If the seller is insolvent, the remaining payoff is just zero. The probability that the seller is solvent is s . When solvent, the seller gets paid one dollar if the buyer is solvent which happens with probability b_j . If the buyer is insolvent the seller repossesses the good and claims δ . The seller must also repay the bank one dollar.

2.2 How Much Trade Credit Will Be Used?

Since trade credit has a clear advantage if repossession proves necessary, the central issue is how close the seller can get to an equilibrium in which all trade is on credit. This is limited by the investor's concern about the quality of the seller's receivables and the consequent willingness to provide loans. When selling to a high type buyer, the seller will provide only limited trade credit because these buyers get better terms directly from the investor. When selling to low type buyers, sellers provide full funding. This is akin to the low type buyer "stretching payables." The more creditworthy the seller, the greater the willingness of the investor to extend funds, and so the more trade credit they provide to the high type buyers.

Proposition 2.1 *Sellers provide full trade credit to low type buyers, and they provide partial trade credit to high type buyers. High type buyers borrow the rest of the necessary financing directly from the investor. The investor provides all necessary funding.*

Proof. Let x be the proportion of a sale to a high type buyer, that the investor will fund. If a seller who actually has a buyer of type i is thought to have a buyer of type h , then the payoff definitions are given as,

$$\pi_{ih} = xL_{sh} + (1-x)b_i - c + sx(b_i + (1-b_i)\delta - 1), \quad i = h, l. \quad (3)$$

We need to verify that, $\pi_{ll} > \pi_l^{ca}$, $\pi_{hh} > \pi_h^{ca}$, $\pi_{ll} > \pi_{lh}$, $\pi_{hh} > \pi_{hl}$.

$\pi_{ll} - \pi_l^{ca} > 0$ can be reduced to $s\delta(1-b_l) > 0$, which is true. $\pi_{hh} - \pi_h^{ca} > 0$ can be reduced to $xs\delta(1-b_h) > 0$, which is again true. In order to have $\pi_{ll} - \pi_{lh} > 0$, we need, $s\delta(1-b_l) > x[(1-s)(b_h - b_l) + s\delta(1-b_l)]$. This will be true if, $x < x_1$, where

$$x_1 = \frac{s\delta(1-b_l)}{(1-s)(b_h - b_l) + s\delta(1-b_l)}. \quad (4)$$

Notice that x_1 is strictly between zero and one. In order to have $\pi_{hh} - \pi_{hl} > 0$, we need $(b_h - b_l)(1 - s) + xs\delta(1 - b_h) + s\delta(-1 + b_h) > 0$. This will be true if $x > x_2$, where $x_2 = 1 - \frac{(b_h - b_l)(1 - s)}{s\delta(1 - b_h)}$.

For these expression to be mutually compatible, we need $x_1 > x > x_2$. After some algebra we find that

$$x_1 - x_2 = \frac{(b_l - b_h)^2(1 - s)(1 - s + s\delta)}{(b_h - b_l)(1 - s) + s\delta(1 - b_l)} > 0 \quad (5)$$

Accordingly these condition are compatible. ■

The intuition for the equilibrium is as follows.¹⁰ Trade credit is more efficient than cash sales. This is because if the buyer defaults the trade creditor can reclaim more value in a repossession than can an investor. Thus if there were no concern about the credit policy of the seller, full trade credit would be offered to all buyers. However if the investor fully funds the seller, he loses touch with whom the seller is relending the money to. Thus the investor restricts the amount loaned to the seller.

To cope with this limited amount of funding, the seller must cut back on the amount of trade credit to extend. Where does the cut back take place? The high type buyer is less likely to default than is the low type buyer. Accordingly the investor will provide more money to a high type buyer in a direct loan. Thus the seller provides full trade credit to the low type buyer. The seller provides only partial trade credit to the high type buyer.

It is commonly observed that when firms are feeling financially squeezed they delay paying their payables. In writings about this fact, it is often left unclear why sellers permit such behavior. According to the equilibrium just derived, low type buyers receive full funding, while high type buyers receive partial funding. One way to interpret this is to say that low type buyers are stretching their payables relative to the high type buyers. This is not due to seller inattention to buyer behavior. It results from the seller coping with constraints imposed by the investor on the seller.

An important aspect of this equilibrium is that it accounts for firms extending some trade credit to other equally creditworthy firms. Most public companies have *both* accounts receivable and accounts payable, so some explanation is needed. Neither the arbitrage approach (Emery

¹⁰This equilibrium satisfies equilibrium dominance, and so no seller has an individual incentive to deviate. There are other equilibria that fail to satisfy equilibrium dominance. In those equilibria a seller with a high type buyer has an incentive to find other methods to show the investor that he deserves better financing terms. In this equilibrium, no such incentive to deviate exists.

(1984)), nor the credit rationing approach (Smith (1987), and Biais and Gollier (1997)) lead one to expect to see such things. For example Biais and Gollier (1997) assert that, “firms which do not suffer from credit rationing do not use trade credit ...”.

Corollary 2.2 *Since the seller prefers higher values of x , the proportion of trade credit offered to high type buyer is, $x = x_1$. Furthermore, $\frac{\partial x}{\partial b_l} > 0$, $\frac{\partial x}{\partial b_h} < 0$, $\frac{\partial x}{\partial s} > 0$, $\frac{\partial x}{\partial \delta} > 0$.*

As the low type buyer becomes more creditworthy, the seller increases the proportion of trade credit provided to the high type buyer. Thus the creditworthiness of the low type buyer has a spillover effect on the amount of trade credit being offered to the high type buyer. This is an effect of the seller attempting to cope with having limited financial resources. As the high type buyer becomes increasingly creditworthy, the seller reduces the fraction of trade credit provided. This occurs because the improved creditworthiness of the high type buyer increases the amount that they can raise directly from the investor. The more creditworthy the seller, the more trade credit is provided to the high type buyer. Finally, as the value that can be reclaimed in a repossession rises, a greater fraction of the sale to the high type buyer is financed by trade credit. This is simply because the advantage of the seller over the investor becomes more important.

The right of a seller to reclaim is a function of the law. Over time these laws have been changed. As documented in Garvin (1996) these changes have often been controversial. Most of the legal changes over the past century in the US have worked to reduce the right of a seller to reclaim in the event of a default. In terms of the model, these changes can be thought of as legally mandated reductions in δ that serve to reduce the reclaimable value without any change in the underlying technology. A marginal reduction in the seller’s right to repossess, does not reduce the extent to which the low type buyer receives trade credit. But it does cause a reduction in the extent to which the high type buyer receives trade credit. The scope for disagreement between firms as to the appropriate policy is apparent.

There is an efficiency gain associated with the use of trade credit. The reclaiming seller is able to realize more value than could a reclaiming investor. So legal policy that artificially weakens the rights of a seller below what is technologically feasible, would not be supported by the analysis.

3 Trade Credit and Long Term Financial Problems

Following Myers and Majluf (1984) a substantial literature has developed showing the importance of adverse selection in understanding corporate financing practices. Corporate insiders often have an advantage over outsiders in assessing the value of the assets in place. Knowing this, the investor takes steps to protect his position. We have abstracted from these empirically important issues so far, in order to isolate the importance of relending. Yet this type of adverse selection interacts in significant ways with trade credit. Therefore in this section of the paper we analyze these interaction effects.

In some cases trade credit, by offering an additional channel through which things can be learned, allows firms to completely get around the damaging effects of adverse selection.¹¹ More commonly the damaging effects cannot be fully avoided. Trade credit serves to channel the effects of adverse selection problems in a particular manner.

3.1 The Model Structure

The model is similar to that in the relending problem. The most important difference is that the outside funding provided to the firms takes the form of equity.¹² This means that the funding represents a claim not just on the good being traded, but also on the other assets of the firm. As in Myers and Majluf (1984), we suppose that the manager is better able to assess the true worth of the corporate assets than can the outside investor. Because of the assumption that funding takes the form of equity, there is no risk of default. Since there is no risk of default, the repossession and relending issues analyzed above do not arise. This is an analytical simplification which helps to clarify the causal relationships that are due to adverse selection with respect to the firm's assets.

At the initial date t_0 , a seller makes a take-it-or-leave-it offer to sell without observing the buyer's type. At the seller's discretion, the offer may require payment in cash, or it may include trade credit terms. At t_1 , observing the seller's offer, the buyer chooses a strategy.

¹¹More precisely, when adverse selection affects only one side of the market, there is an equilibrium in which the other side of the market raises the necessary funding to complete the transaction. That equilibrium is Pareto efficient and maximizes the payoff to the seller.

¹²In an earlier draft of the paper it was shown that essentially the same equilibria arise in the case of debt financing, when debt financing leaves the adverse selection effects in place. That analysis does not offer insights beyond those present in the case of equity. Thus we restrict attention to the algebraically simpler case of equity.

The buyer may decide to take an available offer, or the buyer may decide against buying. If an offer by the seller has been accepted, then at t_2 one of the firms will go the investor to raise the funds necessary to complete the transaction. The investor funds all requests that at least allow him to expect to break even. The loan is made, and production takes place at t_3 . At t_4 all uncertainty is resolved and payoffs are made. All parties are risk neutral and the time value of money is zero.

Consider the seller's problem. The seller will require c in order to produce, where $0 < c < 1$. If the sale is for cash then the seller does not need to approach the investor. If the sale is to be on trade credit then the seller must raise c by giving up an equity stake. The seller has assets in place which may turn out to be valuable, or which may turn out to be worthless. If things turn out well, then the seller's assets in place are worth $A_s > 0$.

For the high type seller the assets have positive value with probability s_h . For a low type seller the assets in place have positive value with probability s_l . By definition $0 < s_l < s_h < 1$. If the seller has a bad draw, the value of the assets is zero. The seller is the only one who knows his type. The seller is a priori equally likely to be either high or low type.

A strategy for a seller consists of posting a pair of prices (p_{ca}, p_{cr}) , where p_{ca} is a cash price and p_{cr} is a credit price. If a seller chooses not to offer trade credit, then we replace $p_{cr} = \emptyset$. Similarly it is possible to set $p_{ca} = \emptyset$. These can be thought of as either not posting a price, or else as posting any price greater than one. If the seller wishes to trade on a particular set of terms, then the entry will be a number between zero and one.

Next consider the buyer's problem. When the buyer takes possession of the good it is converted into 1 dollar for sure. The buyer also has assets in place which may be valuable, or which may be worthless. If valuable, the buyer's assets are worth $A_b > 0$. For the high type buyer these have positive value with probability b_h . For a low type seller the assets in place have positive value with probability b_l . By definition $0 < b_l < b_h < 1$. If the buyer has a bad draw, the value of the assets is zero. Only the buyer knows the buyer's type. A priori the buyer is equally likely to be high type, or to be low type. The buyer type is independent of the seller's type.

The buyer observes the seller's offer and makes a decision. So a buyer observes (p_{ca}, p_{cr}) , and his strategy is to decide whether to take the cash price, take the credit price, or take neither. An important element in that strategy are his reservation prices $(\bar{p}_{ca}, \bar{p}_{cr})$ which are

the maximum that he is willing to pay for cash if only a cash price is quoted (\bar{p}_{ca}), and the maximum he will pay on credit if it alone is offered (\bar{p}_{cr}).

Finally consider the investor. All financing is assumed to take the form of equity. The investor is assumed to be perfectly competitive, and so will demand enough equity to just cover any funds extended. The investor cannot observe the type of either the buyer or the seller. The investor sees both the invoice for the sale and the amount demanded by a firm trying to raise cash.

If there is a pooling equilibrium, the seller's assets in place are valued at $\frac{s_l+s_h}{2}A_s$. The high type seller whose assets are worth s_hA_s is undervalued by the investor; and the low type seller whose assets are worth s_lA_s , is overvalued by the investor in such an equilibrium. Similarly in a pooling equilibrium the buyer's assets in place are valued at $\frac{b_l+b_h}{2}A_b$. The high type buyer whose assets are worth b_hA_b is undervalued by the investor, and the low type buyer, whose assets are worth b_lA_b , is overvalued by the investor in such an equilibrium.

Let f_{mk}^i denote the fraction of firm i 's equity demanded by the investor, where m is the investor's expectation of firm type, k is the amount of funding to be provided. The firm's role as a seller or a buyer is denoted i and so $i = b, s$. The investor's expectation regarding the firm's type denoted m will be one of high (h), low (l), or pooled (p). For example suppose that the seller needs to obtain c dollars, will charge a price of k on trade credit, and is thought to be pooled, then

$$f_{pk}^s = \frac{c}{\frac{s_l+s_h}{2}A_s + k}. \quad (6)$$

If the investor is funding a seller, the production cost c is also the level of funding required for trade credit to be feasible. If the investor is funding a buyer, then the funding pays for a cash transaction. Notice that if the seller has a markup over production costs, then trade credit feasibility requires less outside funding than does a cash sale.

The value of a firm is denoted v_{jt}^i where j is the actual firm type, and t is the sales revenue. Again i shows whether the firm is a seller or a buyer, $i = b, s$. The firm's actual type may be either high (h), or low (l). For instance, if a low type firm sells the good for a cash price of t then,

$$v_{lt}^s = s_lA_s + t. \quad (7)$$

If for example the low type seller does not sell, then sales revenue is zero and so, $v_{l0}^s = s_lA_s$.

The payoff to a seller is denoted as π^s (actual type, investor expectation of firm type, cash price, credit price). For instance, a high type seller, expected to be low, who quotes a cash price of \$1, and refuses to sell on credit is $\pi^s(h, l, 1, \emptyset)$. The payoff to a seller has the following form,

$$\pi^s(j, m, k, t) = (1 - f_{mk}^s)v_{jt}^s, \quad (8)$$

where as before $j = h, l$; $m = h, l, p$; $k \in \{[0, 1], \emptyset\}$; $t \in \{[0, 1], \emptyset\}$. If a seller does not engage in a trade, then he does not raise any funds from the investor, and so $\pi^s(j, m, \cdot, \cdot) = v_{j0}^s$.

3.2 The Constraints

Any suggested equilibrium must satisfy two categories of constraints. First, each firm must satisfy a participation constraint. Second, each firm must find it's suggested strategy incentive compatible. Thus in a pooling equilibrium none of the firms must prefer to separate, and in a separating equilibrium neither firm must prefer to mimic the other type. In general the only nontrivial participation constraints are those subject to potential adverse selection, i.e. the high type seller selling on credit, and the high type buyer paying cash. In this section we point out some general restrictions that follow from the constraints.

3.2.1 Buyers

The maximum that the buyer is willing to pay for cash, if only cash terms are offered, is denoted \bar{p}_{ca} . The maximum that the buyer is willing to pay on trade credit, if only credit terms are offered, is denoted \bar{p}_{cr} . We are interested in characterizing these.

The first observation is that no buyer will pay more than \$1. Both the high and the low type of buyer are able to convert the good into \$1 for sure. The only way that a buyer would agree to pay more than \$1 would be if he could get extra surplus from the investor. When paying on trade credit, he does not borrow from the investor directly, and so we know that $\bar{p}_{cr} \leq 1$. At $\bar{p}_{cr} = 1$, the buyer just breaks even, and so is just willing to participate. The fact that seller has market power means that, $p_{cr} = 1$ which simplifies the analysis.

If buying for cash, the buyer does borrow directly from the investor. But a willingness to pay the seller more than \$1 would reveal the fact that the firm was being overvalued, and so is of low type. Because of the time sequencing, the investor observes the price that the buyer

is agreeing to pay to the seller. Accordingly it will never be profitable for the buyer to agree to pay more than \$1. So $\bar{p}_{ca} \leq 1$.

What is the maximum cash price that the high type buyer will accept if trade credit is not available? This depends on the financing available to the high type buyer. For example, suppose that the investor treats buyers as of pooled type, and so demands a fraction of equity given by $f_{p1}^b = p_{ca}/(\frac{b_h+b_l}{2}A_b + 1)$. The high type buyer is indifferent between paying cash, and not buying if,

$$(1 - f_{p1}^b)(b_h A_b + 1) = b_h A_b. \quad (9)$$

Substitute for f_{p1}^b and solve for p_{ca} ; then denote the solution as \tilde{p} . Thus,

$$\tilde{p} = \frac{\left(\frac{b_h+b_l}{2}A_b + 1\right)}{(b_h A_b + 1)}. \quad (10)$$

If a seller does not offer trade credit, but offers to sell for \tilde{p} , then both buyer types will accept.

Under what condition will the buyer prefer a purchase for cash? His gain from a purchase on credit is $1 - p_{cr}$. His gain from a purchase for cash over credit is going to be

$$(1 - f_{1k}^b)v_{j1}^b - v_{j0}^b > 1 - p_{cr} \quad (11)$$

There is a condition like this for the high type firm and another for the low type firm.

3.2.2 Sellers

Sellers require at least c in order for production to be feasible. The seller would like to get the price as close to 1 as is possible, since that price extracts all the available surplus. If the seller is selling for cash, then we know that $c \leq p_{ca} \leq 1$. If the seller is selling on trade credit, then there is a further issue of the adverse selection by the investor to deal with. Since this only poses a problem for the high type seller, in each proof we need to check the high type seller's participation constraint. We know that the low type seller's constraint will be satisfied trivially. For the high type seller to be willing to sell on trade credit if being pooled we need,

$$(1 - f_{pp_{cr}}^s)v_{hp_{cr}}^s > v_{h0}^s. \quad (12)$$

The second issue is whether the seller will extend trade credit. If he sells for cash the profit is, $p_{ca} - c$. If he sells on trade credit, his profit is $(1 - f_{mp_{cr}}^s)v_{jp_{cr}}^s$. There are separate conditions

such that cash is preferred to offering trade credit; one for the high type seller, and the other for the low type seller. They will both take the form of,

$$p_{ca} - c > (1 - f_{mp_{cr}}^s)v_{jp_{cr}}^s. \quad (13)$$

3.3 Production Costs and Market Equilibria

In this section we characterize the equilibria that can arise. First we explain why there cannot be an all cash equilibrium, an all trade credit equilibrium, nor can there be a partial trade credit equilibrium of the sort analyzed in the relending problem. Then we show how the character of the equilibrium depends on the cost of production.

Suppose that there were to be an equilibrium in which all trade was for cash. The low type seller faces no adverse selection from the investor. Accordingly it would pay the low type seller to deviate by selling equity to the investor, and extending trade credit to at least some buyers. If all buyers were paying cash then the investor must have been treating them as pooled. In that case the high type buyer is being overcharged. He would take the trade credit.

Suppose there were to be an equilibrium in which all trade was on trade credit. In this case the sellers are being pooled by the investor. This is disadvantageous to the high type seller. If the high type seller deviates by offering a very slight price cut for a cash sale, the low type buyers will take it, breaking the equilibrium.

In light of the relending analysis it is natural to ask whether there can be a partial trade credit equilibrium. Since the low type firm will always want to mimic, such an equilibrium would have to involve sellers pooling. However even that cannot work. As will be shown below, the payoffs are linear in c . Accordingly the solution will generally be at a corner involving either no trade credit, or full trade credit.

Since there will be neither an all cash equilibrium, nor an all trade credit equilibrium, the issue is how much of each will be used by whom. The amount of surplus potentially available is central to the nature of the results. Since we normalize the value of the good in the buyer's hands as 1, the amount of potentially available surplus is $1 - c$. If the cost c is low, then not all that much financing is needed, and so the adverse selection has a minor impact. Trade credit will be used. There will be almost no loss of surplus in the equilibrium. As the cost of production increases, the adverse selection effects become more important.

Proposition 3.1 *If the cost of production is sufficiently low, then there exists an equilibrium in which all sellers offer the following terms. For a cash sale the price is $1 - \varepsilon$, and for a sale on trade credit the price is 1. The low type buyer pays cash, and the high type buyer buys on trade credit. The investor treats any buyer paying \tilde{p} or less as being pooled, and those paying more than \tilde{p} as low. Any seller is treated as pooled.*

Proof. To construct the proof we need to be concerned about both participation constraints, and incentive compatibility constraints. For the current equilibrium to hold, two conditions are crucial. First, the high type seller must prefer to participate, $\pi^s(h, p, 1 - \varepsilon, 1) \geq \pi^s(h, p, \emptyset, \emptyset)$. This generates a cost restriction of the form $c < c_1$. Second, the high type seller must be willing to offer trade credit, $\pi^s(h, p, 1 - \varepsilon, 1) \geq \pi^s(h, p, \tilde{p}, \emptyset)$. This generates a cost restriction of the form $c < c_2$.

Buyers strategies: The low type buyer is treated fairly by the investor, and so prefers whichever is lower, the cash price p_{ca} or the credit price p_{cr} . Hence they take the cash price. The high type buyer will pick p_{cr} if he faces a cost of at least ε , due to adverse selection.

Sellers strategies: Consider the low type seller. He receives pooled pricing from the investor so the question is, will this be enough to cause a deviation? He loses ε on sales to the low type buyer, by not charging the full 1 as a cash price. However if the buyer chooses p_{cr} , the seller gains by being pooled by the investor. For ε small enough, the loss on the cash sale is smaller than the benefit on the financing side of the credit sales, and there is no incentive to deviate.

The high type seller participation constraint reduces to a critical cost level c_1 , such that $c < c_1$. In the equilibrium the high type seller earns a profit of $\pi^s(h, p, 1 - \varepsilon, 1)$.

Alternative 1. The high type seller could instead charge a price of 1 and only sell for cash, generating profits of $\pi^s(h, p, 1, \emptyset)$. In order to raise c for one period, he will have to give up $f_{p1}^s = c / (\frac{s_l + s_h}{2} A_s + 1)$, to the investor. The high type seller will be indifferent between, forgoing the sale and financing it by the sale of equity, if

$$(1 - f_{p1}^s)(s_h A_s + 1) = s_h A_s. \quad (14)$$

This solves for c_1 as,

$$c_1 = \frac{\frac{s_l + s_h}{2} A_s + 1}{s_h A_s + 1}. \quad (15)$$

Alternative 2. The high type seller might charge a price \tilde{p} which is the highest cash only price, that the high type buyer will accept. This generates profits of $\pi^s(h, p, \tilde{p}, \emptyset)$. Hence, the

second requirement is that $\pi^s(h, p, 1 - \varepsilon, 1) \geq \pi^s(h, p, \tilde{p}, \emptyset)$. There is a cost level (c_2) such that this condition is satisfied with indifference.

Should the high type seller switch the cash price from $1 - \varepsilon$ to \tilde{p} ? This reduces expected revenue by $1 - \tilde{p} - \varepsilon/2$. The gain is equal to the expected adverse selection cost of raising c from the investor. The cost K , to a high type firm of raising c from the investor is,

$$K = f_{p1}^s (s_h A_s + 1) - c. \quad (16)$$

Substituting for f_{p1}^s and solving, yields the expected cost at

$$\frac{\frac{s_h - s_l}{2} c A_s}{\frac{s_l + s_h}{2} A_s + 1}. \quad (17)$$

The expected cost of adverse selection is less than the loss in revenue $1 - \tilde{p} - \varepsilon/2$ if $c < c_2$. To find c_2 , set $1 - \tilde{p} = K/2$, and solve,

$$c_2 = \frac{((s_h + s_l)A_s + 2)(b_h - b_l)A_b}{(b_h A_b + 1)(s_h - s_l)A_s} \quad (18)$$

So when $c < c_2$, the high type seller will not deviate. Thus neither alternative strategy pays for the high type seller. ■

At an intermediate level of costs there is a balancing of forces between the financing problems of the buyers and of the sellers. Neither undervalued buyers, nor undervalued sellers wish to raise funds from the investor. In order to induce the undervalued buyers to raise funds, the undervalued seller offers to sell for a low cash price. The overvalued seller will offer trade credit and sells at a higher price.

Proposition 3.2 *There is an intermediate range of production costs such that the high type seller will only sell for cash, but charges a lower price (\tilde{p}). The low type seller offers to sell at a price of 1, either for cash or on trade credit. When faced by a cash price strictly less than 1, all buyers accept. When faced with a choice between cash or credit prices of 1, the low type buyer is indifferent between cash and credit; and the high type buyer buys on trade credit. The investor treats any buyer paying \tilde{p} or less as being pooled, and those paying more than \tilde{p} as low. Any seller is treated as pooled.*

Proof. Again there are two central conditions that need to be verified. We need to verify that the high type seller does not prefer to mimic the low type seller, and so $\pi^s(h, l, \tilde{p}, \emptyset) \geq$

$\pi^s(h, l, 1, 1)$. The point of indifference is denoted as c_3 . We need to verify that the high type seller does not prefer to give up trying to make sales to the high type buyer, $\pi^s(h, l, \tilde{p}, \emptyset) \geq \pi^s(h, l, 1, \emptyset)$. The point of indifference is denoted as c_4 .

We also check for nonmimicry. To show that the low type seller does not mimic the high type requires that $\pi^s(l, l, 1, 1) \geq \pi^s(l, l, \tilde{p}, \emptyset)$. The dominance is clear because the high type firm obtains $p_{ca} < 1$ per transaction, whereas the low type firm obtains 1, not being subject to any adverse selection costs.

The high type buyer does not mimic the low. When facing the high seller there is no choice, just cash. When facing the low type seller, the high type buyer is better off paying 1 on credit rather than $1 - \varepsilon$ in cash. This avoids the adverse selection problem.

A seller raising money from the investor is treated as being low type. Thus for the low type seller raising money is a zero net present value transaction. Accordingly he is willing to offer the good at the buyers reservation price, and leave it to the buyer to decide whether the payment of 1 is made in cash or on credit.

Finding c_3 . Does the high type seller prefer to set ($p_{ca} = 1 - \varepsilon, p_{cr} = 1$) rather than charging a cash price \tilde{p} ? If he did so, the seller would expect to supply credit half the time. Given the investor's belief that only low type sellers provide credit, the expected cost of supplying trade credit (K') is given by

$$K' = \frac{(s_h - s_l)cA_s}{s_l A_s + 1}. \quad (19)$$

In the candidate equilibrium the high type seller would rather lose $1 - \tilde{p}$ than incur the expected adverse selection cost, given in (19). So setting $1 - \tilde{p} = K'/2$, substituting for \tilde{p} , and solving yields,

$$c_3 = \frac{(s_l A_s + 1)(b_h - b_l)A_b}{(b_h A_b + 1)(s_h - s_l)A_s}. \quad (20)$$

Finding c_4 . If the high type seller charges \tilde{p} he gets twice the sales. If he charged 1 he would only be able to sell to the low type buyer. Hence, $\tilde{p} - c > (1 - c)/2$. This yields the upper bound on the value of c for which such an equilibrium exists. Substituting for \tilde{p} and solving for c yields

$$c_4 = \frac{(b_l A_b + 1)}{(b_h A_b + 1)}. \quad (21)$$

To have $c_3 < c_4$, we need it to be the case that

$$\frac{(b_l A_b + 1)}{(s_l A_s + 1)} > \frac{(b_h - b_l) A_b}{(s_h - s_l) A_s}. \quad (22)$$

In order for this to hold, there must be a relatively small degree of adverse selection for the buyers, and a high degree for the sellers. ■

Note that the low type buyer is indifferent between the two offers p_{ca} and p_{cr} . It is assumed in the proposition that the low type buyer accepts the cash offer rather than the credit offer when both are offered by the low type seller. It could instead have been assumed that the low type buyer accepts the credit offer. This would be immaterial as long as the investor observed whether the sale was made.

Proposition 3.3 *For sufficiently high costs of production, there exists an equilibrium in which the high type seller charges a cash price of 1, and is unwilling to offer trade credit. The low type seller will sell for cash or on trade credit, and in each case charges a price of 1. When the only available offer is a cash price of 1, the low type buyer accepts it, and the high type buyer does not trade. When both cash and trade credit are available, a high type buyer takes the trade credit. The low type buyer will take either the trade credit or the cash terms; receiving the same payoff in each case. The investor treats all buyers and all sellers as low type.*

Proof. Once again there are two important restrictions on costs. First, the high type seller must not prefer to cut the cash price in order to induce high type buyers to buy, so $\pi^s(h, l, 1, \emptyset) \geq \pi^s(h, l, \tilde{p}, \emptyset)$. The point of indifference is denoted c_5 . Second, the high type seller must not be able to improve his profits by offering trade credit, so $\pi^s(h, l, 1, \emptyset) \geq \pi^s(h, l, 1, 1)$. The point of indifference is denoted c_6 . Since the high type firms do not approach the investor, the participation constraints are trivial.

The low type seller will not want to mimic the high type seller, since he gains by being able to trade with the high type buyer. Thus, $\pi^s(l, l, 1, 1) \geq \pi^s(l, l, 1, \emptyset)$. A seller raising money from the investor is treated as being low type. Thus for the low type seller raising money is a zero net present value matter. Accordingly he will simply offer the good at the buyer's reservation price, and leave it to the buyer to decide whether the payment of 1 is made for cash or on credit.

Finding c_5 . For the high type seller, raising money from the investor entails losses. Consider the decision not to offer credit, but to offer to sell for a cash price of 1. Can he gain by deviating and posting a cash price to attract the high type buyer? The maximum that the high type buyer can raise in cash is \tilde{p} . The high type seller will not gain by deviating if $\tilde{p} - c < (1 - c)/2$, or $c > c_5$, where

$$c_5 = \frac{(b_l A_b + 1)}{(b_h A_b + 1)}. \quad (23)$$

Note that $c_5 = c_4$.

Finding c_6 . The high type seller can also deviate by also offering a credit price of 1 and reducing his cash price to $1 - \varepsilon$. The seller's gain, when encountering a high type buyer is then $1 - c$. His cost is equal to the expected adverse selection cost of raising c from the investor. This cost to a high type seller of raising c from the investor is equal to

$$\left(f_{l1}^s - \frac{c}{s_h A_s + 1} \right) (s_h A_s + 1). \quad (24)$$

Substituting for $f_{l1}^s = \frac{c}{s_l A_s + 1}$, and solving yields the expected cost of adverse selection of

$$\frac{(s_h - s_l)c}{s_l A_s + 1} A_s. \quad (25)$$

Costs of deviating exceed gains, $1 - c$, when $c > c_6$, where

$$c_6 = \frac{(s_l A_s + 1)}{(s_h A_s + 1)}. \quad (26)$$

■

What overall messages are suggested in this section? If the seller's cost of production is low enough, then all sellers are prepared to sell either for cash or on credit terms since the undervaluation of the assets is not such a problem. The amount that is needed is modest. The high type buyer, worrying about the problem of undervaluation of his assets by the investor, buys on credit terms to avoid having to raise additional outside funds. The low type buyer is not worried about undervaluation of his assets by the investor, and so he is willing to pay cash.

If the seller's cost of production is high enough then the high type seller's worry about the undervaluation of his assets by the investor becomes a first order concern. So he only offers to sell for cash. The low type seller does not have to worry about the undervaluation of his

other assets, and so he is willing to sell either for cash or on credit terms. Either way he will demand \$1 to extract all surplus. The high type buyer is willing to buy on credit, but not for cash. The low type buyer is willing to buy either for cash or for credit.

At moderate cost levels, it matters exactly how the various parameters of the problem relate to each other. The low type seller is willing to sell for either cash or for credit, as long as he gets all the surplus. The high type seller is willing to sell for cash. He charges a lower cash price than does the low type seller. This is because he is not willing to sell for credit, but he still would like to attract both the overvalued and the undervalued buyers to buy from him. There is thus a moderating effect on the price of the intermediate good in this case. The loss in market power is at the expense of the high type seller. The gain is received by all buyers.

Consider how these equilibria are related. Since c_2 is larger than c_3 , the equilibria in propositions (3.1) and (3.2) are overlapping. However the equilibria in propositions (3.2) and (3.3) do not overlap because $c_4 = c_5$. Cadsby, Frank and Maksimovic (1998) find that when there are multiple equilibria, efficiency is sometimes helpful in predicting which equilibrium will be observed. For the current theory it seems likely that efficiency from the perspective of the seller may be crucial. If so, then we expect that the equilibrium in proposition (3.1) dominates that in proposition (3.2) when the parameter values are such that both exist.¹³

How does the relative importance of the adverse selection on either side of the market affect the predictions?

Corollary 3.4 *Suppose that adverse selection is very bad for the buyers (b_l and b_h are very far apart), but a minor matter for the sellers (s_l and s_h are very close together). The equilibrium in proposition (3.1) is the one that is likely to arise.*

To see this note that c_1 is roughly 1, and c_2 approaches $+\infty$. Hence the (3.1) equilibrium is likely to be consistent. Next note that c_3 approaches $+\infty$, which rules out the (3.2) equilibrium. Finally note that c_6 will approach 1, which makes the (3.3) equilibrium unlikely.

Corollary 3.5 *Suppose that adverse selection is not much of a problem for the buyers (b_l and*

¹³In any equilibrium under uncertainty, we must take care to specify the beliefs of the firms. As is well known, the equilibrium can be sensitive to the specification of the beliefs held about events that are not observed in the equilibrium. An alternative to the beliefs that we specify, would be to specify that the investor treats deviating firms as low type. That would change the range of parameter values for which the equilibria we derive hold. It does not otherwise change their character.

b_h are very close together), but it is a serious problem for the sellers (s_l and s_h are very far apart). Then the (3.2) equilibrium is the one that is likely to arise.

To see this, note that c_1 is strictly less than 1, but c_2 approaches zero, so the (3.1) equilibrium will not be satisfied. Next note that c_3 approaches 0, and c_4 approaches 1, which means that the (3.2) equilibrium is very likely to be consistent, and it makes the (3.3) equilibrium unlikely.

For there to be no trade between a high type seller and a high type buyer, as in the (3.3) equilibrium, requires a balancing of effects. There must be serious adverse selection on both sides of the market.

There is a sort of asymmetry created by the seller's markup. Less outside funding is needed if the sale is on trade credit rather than for cash. Only the production cost c , needs to be covered by the outside funding. Outside funding of a cash sale must also cover the seller's markup. This tends to favor the use of trade credit, and therefore to work against the (3.2) equilibrium. To see this, suppose that $s_l = b_l$, $s_h = b_h$, and that $A_s = A_b$. Then by condition (22) the (3.2) equilibrium cannot exist.

The literature contains many models of security issuance in which the low type in a pool benefits at the expense of the high type (see Daniel and Titman (1995) for a survey). Our model differs because benefits that a low type buyer would otherwise realize, can be partly removed through the product market relationship. They are removed if the seller finds it profitable to offer trade credit. Trade credit removes the incentive for the high type buyer to pool with the low type buyer. Thus trade credit reduces the importance of adverse selection by allowing external financing by the party with least adverse selection. The party which benefits from adverse selection is not necessarily the lower type. In order to benefit from adverse selection, you have to be the low type doing business with firms that have a worse adverse selection problem than your side of the market has.

4 Empirical Implications

In this section we highlight some of the testable implications of the analysis. The relending and the adverse selection problems will in general coexist. Many of the implications are similar, but there are cases in which they have differing implications. Such cases can be used to assess

the relative importance of these two aspects of trade credit. Since Petersen and Rajan (1997) is the most comprehensive empirical study of trade credit currently available, we put particular emphasis on how our predictions relate to their findings.

The relending problem shows how the use of trade credit varies, as a function of observed creditworthiness. Thus tests can be based on ex ante observable differences between firms. Unlike the relending problem, the adverse selection problem is fundamentally based on the idea that observationally equivalent firms are actually positioned quite differently. This implies that empirical tests of the adverse selection problems cannot be based on ex ante observable features of the firm.

Tests of the adverse selection can be based on differences between industries. Looking between industries, it should be possible to distinguish those industries in which adverse selection is a particular problem, using measures like product heterogeneity, high research and development, the profitability of insider trades, or high advertising expenses. Tests can also be based on the use of ex post realizations to infer those who were ex ante incorrectly valued. This can be done by looking at firms that experienced significant increases or drops in the values of their shares.

Many of the existing theories of trade credit, do not directly account for the fact that it is short term credit. The analysis of the relending problem predicts that trade credit is usually short term credit. Inputs provide collateral supporting trade credit. Finished goods do not. As discussed in section (1.2) once a good is processed or resold in good faith, then as a matter of law the collateral value is gone. Nothing can legally be repossessed by the seller. The investor concern about the relending policy of the seller would no longer be offset by the greater ability to reclaim value in a repossession. Accordingly at that point, direct financing of the buyer would dominate over a continued extension of trade credit.

A number of testable implications follow directly. First, the seller has no advantage over the investor in the collection of cash, and so the extent to which a firm receives trade credit will be independent of its cash holdings. This independence is consistent with the findings of Petersen and Rajan (1997). Second, it accounts for the empirical finding by Petersen and Rajan (1997), that trade credit received by a firm is negatively related to the percentage of inventory that consists of finished goods. Third, it implies that industries with longer inventory

holding periods will have longer trade credit periods.¹⁴ Fourth, if a firm adopts “just in time” inventory policies, then the terms of trade credit that it receives will be shortened.

The analysis of the relending problem predicts that sellers provide full trade credit to low type buyers, and the amount of credit that they provide to high type buyers is an increasing function of the seller’s creditworthiness. Thus empirically we expect to see firms both extending and receiving trade credit in transactions with firms of similar creditworthiness. This contrasts with the predictions of theories stressing the price discrimination role of trade credit, or its role in helping a financially troubled buyer. We also expect to see that more creditworthy firms extend more trade credit overall, as is documented in Petersen and Rajan (1997).

The advantage in repossession is likely to be more important for industries with imperfectly competitive second hand goods markets. Holding the physical perishability of the good constant, the presence of a highly efficient second hand goods market will reduce the advantage that the seller has over the investor. Hence the investor will finance the buyer who will then pay cash more often in such industries.

The legal ability of creditors to repossess collateral in a bankruptcy will affect the relative use of trade credit. This suggests two types of tests. First, within the US there have been legal changes that marginally reduced the ability of sellers to reclaim goods. This is not predicted to affect all firms equally. Such changes should have been followed by an increased use of cash sales, particularly by the more creditworthy buyer.

Second, across countries there are different legal systems. Some systems are more favorable to seller repossession than are other legal systems. This could also be used to construct a direct test of the theory. It is well known that some in some countries trade credit is more important than in others, but we have not seen a test of how this matches with their legal systems.

If the outside observer can distinguish industries with insignificant asymmetric information from those severely affected, then adverse selection has directly testable implications. In those industries in which asymmetries of information about the values of the sellers assets in place are present but small, all sellers will offer to sell for both cash and credit, the differences in the terms offered by different sellers will be small, and differences in the cash and credit prices

¹⁴There is some suggestive evidence of such timing effects. For example the average number of days until the trade credit is repaid is shorter in industries such as food, paper goods, or petroleum products, where the expected time to sale seems to be shorter. Notably long repayment periods are in industries such as automotives and industrial equipment.

charged by an individual seller will also be small. At the other extreme, in those industries in which there are large potential asymmetries among both the buyers and the sellers, some (undervalued) sellers will only sell for cash, whereas other (overvalued) sellers sell for both cash and credit. However, observed cash and credit prices will again be similar, although the availability of credit differs.

For those industries in which both sellers and buyers face significant, but not overwhelming adverse selection when dealing with the investors, there is a moderating effect. Undervalued sellers demand cash and do not offer credit terms, whereas other sellers sell offer both cash and credit terms. In particular the cash price demanded by the undervalued sellers is predicted to be lower than the cash price demanded by the overvalued sellers. This difference is predicted to be greater than the difference between the cash and credit prices offered by the overvalued sellers.

By offering trade credit the seller may be able to increase the price he charges.¹⁵ Overvalued firms will tend to be extending a greater than average amount of trade credit. They will be taking less than an average amount of trade credit. Undervalued firms will tend to be doing the reverse.

Petersen and Rajan (1997) find greater extension of trade credit by firms with negative income, and negative sales growth. As they point out, this does not follow from the previous theories of trade credit. It is consistent with the adverse selection approach. Suppose that a firm has been undervalued, and changes to being overvalued. This pattern is particularly likely for high growth firms that reach a turning point in their opportunities.¹⁶ It is likely that insiders recognize the change before the investor. Such a firm will increase sales on trade credit, and reduce the amount of trade credit that it takes from its own suppliers.

It is popular to relate credit practices to profitability, and interpret the causality as running from credit policy to profits. There is an institutional literature which does precisely this, and then recommends demanding early payment from buyers while stretching a firm's own payables

¹⁵Petersen and Rajan (1997) find that firms with higher gross margins have higher accounts receivable. This matches well with the prediction that by extending trade credit a seller can demand a higher price from at least some buyers. However this is not a strong test of the theory, since this prediction is shared by other theories of trade credit, such as Brennan, Maksimovic and Zechner (1988).

¹⁶This can also happen to large firms. For example, the Harvard Business School case on Westinghouse and its teaching note present an example and interpret the increased offering of trade credit as a reflection of agency problems.

(see Masonson (1990) for instance). Similar advice can be found in many finance textbooks. The analysis suggests that greater caution is needed.

Suppose that an analyst looked at a sample of initially seemingly identical firms, some of whom turned out to be more successful than others. Suppose that the effects found in our analysis of adverse selection are at work. Then the more successful firms will have extended less trade credit, taken more trade credit, and on average charged lower prices. In contrast to the causal interpretation given to such correlations in the institutional literature, in our model these factors are reflective of undervaluation, rather than causal of success.

Our interpretation can be tested using ex post analysis of firms that had significant stock market declines. Prior to such declines, we would predict an increases in sales on trade credit. Similarly firms that registered significant stock market increases are predicted to have reduced their sales on trade credit, prior to the increase. These effects are predicted to be more pronounced in industries in which the adverse selection effects are stronger, such as those with very heterogenous products or those with substantial research and development expenses.

5 Conclusion

Purchases are frequently financed by the seller, rather than by investors dealing directly with the buyer. This may appear inefficient, since in principle the seller can only offer trade credit if he can raise money from the investor. We argue that although the seller does not specialize in the provision of credit, he has two advantages in financing the transaction that arise because of his relationship with the buyer.

First, the seller is in the industry, whereas the financial intermediaries are not. If things turn out badly, then the good needs to be repossessed and resold. The seller can recoup more value than can an investor. This makes it efficient for the investor to lend to the seller, and for the seller to offer trade credit. However the seller may have an incentive to provide too much credit to risky buyers. We analyze conditions under which the sellers advantage in repossession exceeds the costs associated with relending.

Second, uncertainty about the value of a firm's assets in place, as in Myers and Majluf (1984), makes it costly for buyers to raise capital from the investor. Because the seller also transacts with the buyer in the goods market, he may be able to mitigate this adverse selection

cost. The seller can offer different prices for cash and credit transactions. We show that when the adverse selection problem affects both buyers and sellers, there is a balancing act. In general, transactions will be financed by the party that faces lower costs of adverse selection.

We have analyzed these two aspects separately in order to isolate their implications. However the relending and the adverse selection problems will normally coexist. In some respects they lead to different predictions, so their relative importance can be determined empirically. The study by Petersen and Rajan (1997) supports elements of each approach, thus it is left to future empirical work to distinguish these more sharply.

As discussed in section (4) there are a number of empirical observations that are accounted for by our approach. Four of these are central. First, the theory accounts for the basic fact that trade credit is short term credit. Second, the theory accounts for firms simultaneously taking and extending credit to other firms with similar levels of creditworthiness. Third, the theory shows that the conventional advice that firms should “collect early and pay late,” may be misguided advice. Fourth, the theory can account for the fact that when firms prospects start to deteriorate, they often respond by increasing the extent to which they offer trade credit to their buyers.

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