Trade Credit, Quality Guarantees, and Product Marketability

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■ In recent years, with the wave of corporate defaults, it has become increasingly evident that asset management is at least as important as liability management. A dominant portion of a firm's time and resources is dedicated to managing working capital, and a major component of working capital is trade credit. Trade credit appears on both sides of the balance sheet. For the buyer, it is a source of financing through accounts payable, while for the seller, trade credit is an investment in accounts receivable. Although trade credit has long been an important source of financing for corporations, it is one of the least understood methods of doing business.[1]

Theories justifying trade credit have evolved in different but not mutually exclusive directions. Financially based models, as developed by Schwartz [14] and Emery [5], center on the "credit" aspect. Brick and Fung [4] have offered tax-based reasons for trade credit, while Emery [6] and Smith [15] have developed marketing models. Recently, Mian and Smith [13] discussed and documented four methods of financing trade credit: captive finance companies, factoring, accounts receivable secured debt, and general corporate debt. To date, however, there has been little empirical evidence explaining why and to what extent firms extend trade credit.

The purpose of this paper is to extend the existing theories of trade credit and to provide relevant empirical evidence. We focus on the sellers' decision to extend trade

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[1] According to the 1991 *Statistical Abstract of the United States*, at the end of 1989 there was over 740 billion dollars outstanding in trade payables by nonfinancial corporations.

credit and develop a reduced form model reflecting supply and demand influences.[2] We build on an idea first suggested by Smith [15], that a major purpose of trade credit is to provide product quality guarantees, and thus enhance marketability. We argue that when there is informational asymmetry about firm type and product quality and in the absence of alternative means of establishing reputation, trade credit can serve to distinguish high- and low-quality goods (and producers). Centering on producers rather than customers, we test the predictions of our model as well as those of the more traditional explanations for trade credit. Our empirical results are consistent with operational and quality control explanations, but inconsistent with a pure financing motive.

The remainder of this paper is organized as follows. Section I summarizes the previous trade credit literature. In Section II, we review the historical evolution of trade credit. Section III develops our model and its testable implications. In Section IV, we summarize the empirical predictions of the alternative theories, develop our empirical proxies, and present our results. Section V concludes with a summary and implications of our findings.

I. Trade Credit and Traditional Models

Traditional financial models of trade credit rely on capital market imperfections, such as transaction or information costs. One financial-based theory for the use of trade credit was developed by Schwartz [14], who suggested that firms that can obtain funds at a relatively low cost will offer trade credit to firms that must pay higher costs to financial intermediaries. Schwartz's model predicts that larger, more financially secure producers will offer trade credit to their smaller, less financially secure customers. He also suggests that when credit is tight, the large, financially stable firms will increasingly offer more trade credit to maintain their relationship with their smaller customers, who are "rationed" from direct credit market participation.[3]

Brick and Fung [4] develop a model in which firms in relatively high tax brackets gain by offering trade credit to firms in lower tax brackets. Thus, buyers prefer trade credit only if their tax bracket is lower than that of sellers. Otherwise, the buyer can borrow at a lower after-tax cost than the seller and will prefer to buy at the lower cash price. Further, within a given industry, sellers with tax rates below the industry average rate cannot profit from offering trade credit. Empirically, Brick and Fung's model implies that firms that find it optimal to extend trade credit will also find no tax advantage in using it.[4]

Emery's model [5] is based on information costs. Capital market imperfections require selling firms to maintain adequate liquid reserves that they either can invest in marketable securities or lend out through trade credit. Imperfections also allow selling firms to acquire knowledge about customers' ability to pay at a relatively low cost. This creates an informational advantage over third-party intermediaries and allows sellers to offer trade credit at an implicit interest rate lower than the purchaser can obtain elsewhere, but higher than they can earn on short-term, low-risk commercial paper. Emery's and Schwartz's models both imply that larger, more financially secure producers will offer trade credit to their smaller customers. In addition, more liquid firms will extend trade credit as an alternative to investing in marketable securities.

Emery [6] focuses on trade credit as an operational tool. His work is based on Alchian [1], who addressed the role of uncertain product demand in a firm's operating decisions. As demand fluctuates, sellers face two alternatives: either they can allow selling price to fluctuate so that the market always clears, or they can vary production to match demand. Either option is quite costly. If price varies, potential buyers face extremely high costs of information search. If production varies, sellers face extremely high production costs. Alchian suggests that a possible lower-cost alternative is to form either a production queue by increasing inventories or a buying queue by creating longer times to delivery. Emery expands and adapts Alchian's analysis by noting that trade credit can be used to create a "selling" queue. Providing more lenient terms on trade

[2]Extending or testing theories such as Brennan, Maksimovic, and Zechner's [3] model, in which trade credit provides a mechanism for price discrimination among customers, is beyond the scope of the paper.

[3]Several surveys done by Hill, Wood, and Sorenson [9] indicate that firms do not change their stated terms when money is tight. However, since stated terms and "actual" terms may differ, it is possible that collections are adjusted in accordance with economic conditions and the availability of funds. Further, no mention is made of the fact that nominal prices of goods might rise when money is tight.

[4]In theory, it is possible to both use and extend trade credit. Consider a firm with a midlevel marginal tax bracket that would extend trade credit to firms with a lower marginal tax rate and use it to purchase from firms with a higher marginal rate. In practice, however, large firms tend to fall into one of two categories: either they are taxed at the maximum marginal rate (e.g., 34%) or they are in a tax loss situation and pay no taxes. Thus, if the tax theory is correct, we should find that large firms either extend or use trade credit, but do not do both.

credit reduces the effective price buyers pay, while maintaining the nominal price. Emery suggests that when demand drops, terms can be relaxed, whereas when demand increases, terms can be tightened.

Finally, in a 1987 paper, Smith [15] developed a model where, with asymmetric information about the buyer's creditworthiness, sellers offer two-part credit terms because they can identify prospective defaults more quickly than financial institutions.[5] She also suggests that trade credit may be used by sellers to warrant product quality. Sellers recognize that they must establish a reputation for product quality and use trade credit as a means of generating repeat sales; it is an investment by the seller to get the buyer's sales, as well as a means of generating information on the buyers' default risk. The marketing effort required to make the initial sale is costly, and it is in the seller's interest to maintain an ongoing, continual relationship with the buyer; if the buyer goes elsewhere in the future, the seller loses the total previous investment in the buying firm. Thus, trade credit becomes a means by which sellers can guarantee quality to buyers and ensure repeat sales. Prior to developing our model, in the next section we review the historical evolution of trade credit.

II. Historical Evolution of Trade Credit in the United States

One observation often found in papers suggesting a pure financing motive for trade credit is that in colonial times there were no established financial institutions and trade credit provided the only way for new merchants to finance working capital. While the observation is indeed correct, it explains neither why trade credit was widespread in England in the 18th century when central banking existed, nor why it continued to be used after the United States established financial institutions. Nor does it explain industry-specific terms or why trade credit exists in some competitive environments, but not others.

During colonial times, trade credit was extended for about one year. Bad debts were almost nonexistent, even though payment terms were quite uncertain. Travel was difficult; merchants usually purchased goods once a year. By the early 1800s, payment terms had shortened to about six months. Merchants now visited commercial centers twice a year to buy goods. Transactions took place between supplier and merchants, and previous purchases were paid for when new goods were purchased. Since few sellers could afford to carry financing for six months or longer, the "domestic draft" or "bill of exchange" came into being. After the Civil War, the development of a nationwide transportation system brought tremendous changes in the economy. Merchants now purchased goods more frequently. Manufacturers grew larger and sold their goods nationwide, and payments were more frequently made by mail. Credit terms of one or two months now became the norm.

Following World War I, a variety of credit terms were observed. They were, however, relatively uniform within industries and appeared to be based on the frequency of repurchase and the uniqueness of the product. For example, foods and other perishable items typically had very short terms of less than 30 days. In contrast, most nonperishable goods were sold net 30 to 60 days. This development of industry-specific terms is difficult to explain in a financial context, but is consistent with trade credit as a means of verifying product quality for relatively unknown, unique goods. This was noted by Ettinger and Goleib [8] in 1917, as follows:

> The manufacturer or jobber of a standard, nationally advertised brand of goods, which the dealer must have in stock, can demand from the buyer, quick terms. Whereas, those selling substitute goods may have to offer a longer term in order to place their goods with the dealer. [8, p. 58]

Thus, Ettinger and Goleib make note of the historical importance of product quality guarantees and the availability of substitute goods that are similar, but not identical to each other. Consistent with this approach, we note that agricultural goods, produced in markets as close to perfectly competitive as possible, have always been sold on a cash rather than on a credit basis.[6]

[5]There are two kinds of trade credit policies. The first defers payment (e.g., net 30), while a two-part credit offer both defers payment and provides a potential discount (e.g., 2/10 net 30). Although consistent with our theoretical model, the empirical portion of the paper, like most of the literature, refers to the former.

[6]Of course, market power may also be important for trade credit. For example, consider the Diamond Syndicate, controlled by DeBeers and their marketing agent, the Central Selling Organization. This closed market, called the Buyers' List, is limited to 200 buyers and accounts for 80% of all sales of rough diamonds. Each month, the Syndicate prepares a packet of diamonds for each buyer, quality and price being determined by them. All payments are required in advance of examining the packet. The packet may be examined by the buyer but must be accepted or rejected as an entity. Rejecting packets is quite risky and may mean elimination from the Buyers' List. Not surprisingly, it is seldom done. See Lenzen [10].

The historical evidence suggests that while there may be a financial motive for trade credit, guaranteeing product quality serves a major purpose as well. In the next section, we formally develop a model, based on Smith, showing how trade credit serves as a product guarantee and thus enhances product marketability.

III. An Extension of the Theory of Trade Credit

In this section, we present a simple model portraying the incentives facing firms engaging in trade credit.[7] The purpose of the presentation is to highlight the intuition behind the use of trade credit as a quality signal. To focus on the important issues, many simplifying assumptions are made. However, the basic outcome is robust to many reasonable extensions.[8]

A. A Simplified Model of Trade Credit

Assume two types of firms in the market. Some firms produce a low-quality good while others produce a high-quality good. Both have an average cost of C.[9] Markets are perfectly competitive in the sense that there is no quantity restriction on the production of goods of either quality. Under full information, the price that can be obtained for a good of quality 1 is $P1$ and for a good of quality 2 is $P2$, where $P2 > P1$. Consumers have priors about the quality distribution of firms and, for simplicity, are assumed to be risk-neutral. There are two classes of consumers in the market. Class 1 is only interested in low-quality goods. They will, of course, be willing to take any good offered, but never will pay more than $P1$. The other class of consumers, Class 2, is willing to pay the higher price, $P2$, for higher quality. If they know that low quality is offered, they either will pay $P1$ or will stay out of the market.[10]

We further assume that the firms have no established reputation and hence the quality of goods sold cannot be determined initially (in period 0). However, in period 1, consumers can ascertain true product quality and may return the item to the producer if they discover they have been cheated.[11] For simplicity, we assume that producers are locked into producing either high or low quality, but cannot produce both. Trade credit in this framework consists of the deferred payment terms extended to buyers until they verify product quality. The rules of our game allow producers to offer trade credit at a rate k, $k < r$ where r is the "appropriate" rate of return. We demonstrate below that for any prior, α, held by consumers, a pooling equilibrium can be ruled out. However, a separating equilibrium can be obtained in which "good" firms will extend trade credit, whereas bad firms will not.

Lemma: A pooling equilibrium at a cash price of $\alpha P1 + (1 - \alpha)P2$ is not sustainable for any $0 \leq \alpha < 1$.

Proof: The "low-quality" consumers will not pay more than $P1$. Hence, they are out of the game.

The high-quality consumers, given risk neutrality and a prior that a proportion, α, of goods is of low quality, will be willing to pay $\alpha P1 + (1 - \alpha)P2$ in period 0. In the presence of trade credit offered at a rate k, for any α and any $k < r$,

$$\alpha P1 + (1 - \alpha)P2 \times (1 + k)/(1 + r) \leq \alpha P1 + (1 - \alpha)P2.$$

Thus, consumers are always willing to pay either $P1$ or use trade credit and pay $P2$ rather than pay the average price. By setting k arbitrarily close to r, it easily can be shown that for any prices $P1$, $P2$, such that $P2 > P1$, high-quality producers will be better off deviating from the pooling equilibrium; i.e., extending trade credit, rather than settling for the expected price. Therefore, a pooling equilibrium is not possible.

We now turn to the separating equilibrium and examine the incentives of high- and low-quality producers to pro-

[7]The basic model is similar to one developed by Emery and Nayar [7], although their model is directed more towards the terms of trade credit rather than its existence. It is also similar to a recent paper by Biais, Gollier, and Viala [2], who use asymmetric information to explain trade credit within the context of a signaling model.

[8]For example, the qualitative results are easily extended to multiple quality levels. In that case, there are two possible outcomes. Either there is only one quality level extending trade credit or there will be varying terms across quality classes. As a second example, we assume competitive markets. An equilibrium in a market with monopolistic competition would create similar incentives. However, in both cases, the presentation would be more cumbersome.

[9]C is each firm's average cost per unit for its optimal choice of quantity, Q^*. We prefer this presentation to the more detailed profit expression when quantity is determined by the usual rules. Also, we easily can extend the discussion to a case where there are two costs, $C1$ for the lower-quality firms and $C2$ for the better ones, with no change in our qualitative results.

[10]We could assume that high-quality consumers will never buy low-quality goods, but Lemma 1 shows that our somewhat more general setting works equally well.

[11]This assumption closely follows practices where trade credit is extended from wholesalers to small retailers and could also be thought of as an approximation, within a one-period model, of a situation of no repeat purchases.

vide trade credit. We analyze low-quality producers in Case 1 and high-quality producers in Case 2.

Case 1A: In this scenario, the firms that produce the low-quality good, sell it for a cash price $P1$. Profit in this case is equal to $P1 - C$.

Case 1B: Here some firms that produce low-quality goods may attempt to pass them off as high-quality merchandise.[12] However, to induce consumers to pay the higher price $P2$, such firms must extend trade credit. Once consumers receive and examine the goods, they recognize inferior quality and return the items to the supplier.[13] Since quality has been revealed, goods can be sold only at a price $P1$. Firm profit is now $\pi_i = P1/(1 + r) - C$, which is strictly less than in Case 1A. We conclude that, in our framework, there is no incentive for a poor-quality firm to cheat by attempting to represent its product as being of high-quality.

Case 2A: Consider a firm producing high-quality goods and selling them as such. First, assume they sell the goods on a cash basis for a price $P1$. Profit is $\pi_i = P1 - C$.

Case 2B: Suppose the firm extends trade credit at a rate k and earns a profit equal to the present value of the selling price, $P2$, plus interest earned on the trade credit, less the operating costs; $\pi_i = P2(1 + k)/(1 + r) - C$.

Comparing Cases 2A and 2B, the choice seems to be unclear ex ante, because if $P2(1 + k)/(1 + r) < P1$, then good firms may choose to sell immediately at $P1$. However, we know from Lemma 1 that consumers will take credit at any rate of return that is strictly lower than the market rate. Since $P2 > P1$, one can always set k such that $P2(1 + k)/(1 + r) > P1$. This leads to testable Proposition 1.

Proposition 1 (separating equilibrium): If there are two separate classes of firms, one producing high-quality goods, and the other low-quality goods, then in the presence of trade credit, the low-quality firm will not extend trade credit, whereas the high-quality firm will extend trade credit.

It is straightforward to see that this nonmimicking equilibrium survives all the standard refinements. When many firms produce goods of varying quality and if quality is unknown ex ante, trade credit can distinguish the better firms from the worse ones. Under our assumptions, producing firms bear the cost of providing information to consumers at a cost of $P2[(r - k)/(1 + r)]$, which is lower as k approaches r. One can, of course, conjecture that if it is possible to provide reliable information for less than the cost of extending trade credit, this may be done.

Trade credit allows buyers to assess quality prior to payment. Thus, the model's results apply to firms where quality is unknown at the time of purchase; i.e., firms that do not have an established reputation for product quality or firms that produce unique products with close, but not identical, substitutes. If firms have a reputation for quality, or if the product is nearly identical to many other products, trade credit serves only a limited purpose; it makes any existing guarantees more credible. Note that trade credit substantially differs from money-back guarantees or warranties. If payment is received at the time of sale, then in order to take advantage of money-back guarantees or warranties, the buyer must convince the seller that quality is not as promised. Further, the seller must still be in business. With trade credit, the decision is transferred, in part, to the buyer. By withholding payment, the buyer induces the seller to make good on the promised quality. Also, if the seller goes out of business, the buyer has not paid and has lost nothing.[14] Once reputation is established, trade credit becomes less important, since quality is assumed ex ante.

In the context of the model, trade credit serves as a quality signal. If all else is equal (the same item produced for the same end use), it is reasonable to assume that it takes longer to produce high-quality goods than low-quality goods, since, at the very least, quality-control testing must be performed. The additional production time is necessary to perform quality-control tests and build in fewer maintenance requirements. Thus, the model directly leads to an empirically testable hypothesis, *H1*:

[12]We do not mean to suggest that all firms producing lower-quality goods attempt to cheat. If a firm produces a low-quality product that is priced appropriately, there is no problem since there will be consumers who demand low-quality, low-priced goods. We do suggest, however, that without restrictions, at least some low-quality producers will have incentives to price their products as if they were high-quality merchandise.

[13]The consumer is not charged for the option to return the goods. In most realistic cases, a consumer who is dissatisfied is allowed to return the goods at no cost (except for shipping). We view the firm as bearing this cost, including the cost of a below-market interest rate, to provide quality information credibility.

[14]This is particularly important for buyers of products from start-up firms. Since a substantial proportion of new firms fail in the early stages, money-back guarantees or warranties may not be an acceptable alternative to trade credit.

H1: Since higher-quality firms provide more trade credit than lower-quality firms, firms with a longer production cycle will extend more trade credit than firms with a shorter cycle.

A second hypothesis, *H2*, follows from the discussion about the role of reputation and differentiates between firms with established reputations and those that need to offer trade credit to emit a quality signal. Because large firms usually have an established reputation, more is known ex ante about product quality and they have little need to extend trade credit. However, smaller firms may not yet have an established reputation and may need to extend trade credit to guarantee product quality.

H2: Small firms will extend more trade credit than large firms.

B. Extensions of the Model

While the simplified model provides a satisfactory array of predictions, one could extend it in several ways.[15] Perhaps the most interesting extension is to the case in which quality cannot be completely ascertained by the time payment comes due. Assume that consumers at time 1 can correctly identify product quality with probability β, but with probability $(1-\beta)$ they will misjudge, and erroneously think that the goods are of high quality, whereas indeed they are of low quality. For the firm producing high-quality products, the total profit is unchanged: $\pi = P2(1+k)/(1+r) - C$. High-quality firms still have no incentive to cheat.

Low-quality firms, if they identify themselves correctly, earn profits of $P1 - C$, as before. However, if a low-quality firm misrepresents itself as high quality, it may get away with it. Thus, expected profit consists of the profit from producing low-quality goods and selling them as high quality, if they are not discovered, and the present value of the lower price if they are discovered;

$$\pi_1 = [P2(1+k)/(1+r) - C](1-\beta) + \beta[P1/(1+r) - C].$$

Instead of fully developing a new equilibrium, highly dependent on the values of all parameters in question, we will briefly discuss the incentives that such a structure induces. It is easy to see that "bad" firms will tend to "cheat" less the higher is the rate of discount, r, and the higher the probability they will "get caught" (lower β). Also, the higher the price differential between $P2$ and $P1$, the greater the potential gain from cheating and the more bad firms will try to pass themselves off as good-quality producers. Thus, lower-quality firms will tend to cheat less if the cost of trade credit is higher. In a real-world setting, we may expect firms to discourage cheating by exerting influence on the variables they control: the price, $P2$, and more importantly, the cost of trade credit, k. "Better" firms thus may benefit from a higher price differential and a higher cost of trade credit $(r-k)$. This leads to the following testable hypothesis:

H3: Increasing the cost of extending trade credit reduces incentives to cheat.

Thus far we have assumed β to be constant, which may not be true. Consider a situation where β may change over time, and where the customer has the choice of paying after 30 days or after 60 days. If the probability of detecting true quality increases over time, customers will pay later and credit will remain outstanding for a longer period than might otherwise be the case. This discussion leads to our final testable hypothesis:

H4: Firms producing goods where product quality is difficult and time-consuming to ascertain will extend trade credit over longer periods.

The next section focuses on the unique contribution of our paper, the empirical evidence. We describe our sample and methodology and then present and analyze our results.

III. Evidence

Our sample contains all industrial (SIC 2000 through 3999) firms with data available from COMPUSTAT for the three-year period ending in 1987. Trade credit policy is defined as the average time receivables are outstanding and is measured by computing each firm's days of sales outstanding, *DSO*, as accounts receivable per dollar of daily sales. To reduce variability, *DSO* and all other measures are averaged over a three-year period.

For most firms, *DSO* measures two separate aspects of trade credit: the length of time credit is outstanding as well as the fraction of total sales made on credit.[16] Ideally, we

[15]One way, which will not be discussed here, is to examine industry equilibrium with firms which can produce both low and high quality. Such equilibrium will follow from the cost structures including a different initial investment. While interesting theoretically, it would not contribute much to the paper at hand.

[16]If all the firm's sales are made on credit terms, *DSO* indicates only the length of time sales are outstanding. In addition, *DSO* is a perfectly correct measure of credit policy only if sales remain at the same level over the period. If sales are increasing (decreasing), *DSO* will be biased upwards (downwards). See Lewellen and Johnson [11].

would like to separate the two facets of trade credit policy. For example, Hypotheses 1 through 3 relate to the fraction of sales made on credit, while Hypothesis 4 concerns the length of time credit is outstanding. By using *DSO*, we combine both aspects of credit policy and cannot distinguish between them. We use *DSO* rather than another measure for purely practical reasons; the only firm-specific item of data on trade credit available is the accounts receivable balance.[17]

A. Summary of Testable Hypotheses and Empirical Proxies

Hypothesis 1 predicts that longer production time should be positively related to trade credit. We proxy production lead times by each firm's asset turnover, *TURNOVER*, measured as sales per dollar of total assets less accounts receivable. The lower the turnover, the more trade credit should be extended.[18]

Hypothesis 2 states that firms without an established reputation will extend more trade credit than firms with a reputation for product quality. Smaller firms are less likely to have established a reputation. Therefore, we hypothesize that smaller firms should extend more trade credit than larger firms. Firm size, *SIZE*, is measured as the natural log of total assets.[19]

Hypothesis 3 predicts that high-quality producers may discourage low-quality firms from falsely signaling by increasing the cost of trade credit. Good-quality producers, knowing their product will outlast the quality-control period, may increase the implicit cost of trade credit by financing receivables either by borrowing directly, or by financing their own purchases through accounts payable. Low-quality producers will find it too costly to do so. Short-term borrowing, *STBORROW*, is computed as the sum of short-term borrowings as a percentage of sales, averaged over a three-year period. The use of trade credit (accounts payable policy) is proxied by each firm's days of payables outstanding, *DPO*, computed by averaging accounts payable divided by daily costs of goods sold.

Finally, Hypothesis 4 implies that firms will match trade credit periods with the time required to observe product quality. It is reasonable to assume that firms purchasing high-tech products, such as computers, other electronic goods or machinery, require a longer time period to ascertain quality. Therefore, buyers of such products may require longer trade credit terms to allow for uncertainty resolution. Alternatively, buyers of perishable products where quality is readily observable, such as food and tobacco, only require a short time to resolve uncertainty, and they are therefore willing to accept shorter terms. We measure the length of time required to observe product quality with two dummy variables. Following Titman and Wessels [16], we define technical industries as those in SIC 3400-3999. A dummy variable, *OBSERVE1*, equals one if firms are in a high-tech industry and zero otherwise. We designate food and agricultural firms (those in SIC 2000-2199) as those producing easy-to-observe perishable goods. A second dummy variable, *OBSERVE2*, equals one if firms are in a perishable industry and zero otherwise. We expect the dummy *OBSERVE1* to be positively related to trade credit terms, and the dummy *OBSERVE2* to be negatively related.

In summary, the product quality theory predicts positive associations between *DSO* and the use of trade credit (*DPO*), short-term borrowing and ability to observe quality, and negative associations between *DSO* and firm size, brand recognition and turnover.

In contrast, the traditional theories suggest opposite empirical regularities. The financial, tax and liquidity theories predict that firms extending trade credit will not use trade credit themselves and suggest a positive association between trade credit policy and firm size. Finally, the liquidity theory implies that liquid firms extend more trade credit. Thus, they do not need to borrow, and the association between short-term borrowings and trade credit should be negative.

Exhibit 1 compares the empirical predictions of the traditional and product quality theories of trade credit.[20] We present each empirical proxy and its expected relation to the extension of trade credit.

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[17]Other measures that would allow us to distinguish between terms and level of trade credit include the percentage of sales made on credit and the collection experience for credit sales. Neither item of data is available.

[18]The obvious measure of quality, production lead time, is not available. Since turnover is slower for products that take longer to produce, we proxy lead time by asset turnover. We also used inventory turnover. Although inventory turnover is quite variable, we obtained similar results.

[19]We also measured firm size as the natural log of sales with virtually identical results.

[20]The empirical implications of the pure financial, tax and liquidity theories are nearly identical. We list the theories separately in Exhibit 1 solely to indicate which of the variables apply to a specific theory. We make no effort to distinguish among them.

Exhibit 1. Empirical Predictions of the Various Theories of Trade Credit: Predicted Relation Between Extension of Trade Credit (*DSO*) and Explanatory Variables

	Theories of Trade Credit			
Variables	Product Quality	Financial	Tax	Liquidity
TURNOVER	–	N/A	N/A	N/A
SIZE	–	+	N/A	+
DPO	+	–	–	–
STBORROW	+	N/A	N/A	–
OBSERVE1	+	N/A	N/A	N/A
OBSERVE2	–	N/A	N/A	N/A

Notes:

TURNOVER is sales as a percentage of total assets less accounts receivable. It is a proxy for the length of production time (lower turnover implies a longer production cycle) and should be negatively related to trade credit policy (Hypotheses 1 and 4).

SIZE is measured as total assets less accounts receivable. It proxies for market reputation (Hypothesis 2) and should be negatively related to trade credit.

Short-term borrowing (*STBORROW*) is computed as all short-term borrowings as a percentage of sales. Accounts payable policy is proxied by each firm's days of payables outstanding, *DPO*, computed by averaging accounts payable divided by daily costs of goods sold. Both variables measure attempts to increase the implicit cost of trade credit and should be positively related to credit policy (Hypothesis 3).

OBSERVE1, a dummy variable for high-tech firms, proxies for time to observe quality and should be positively related to trade credit policy (Hypothesis 4).

OBSERVE2, a dummy variable for perishable goods, proxies for time to observe quality and should be negatively related to trade credit policy (Hypothesis 4).

B. Results of Univariate Tests

Descriptive data and the distribution of variables measured during the three-year period ending in 1987 are presented in Exhibit 2. Manufacturing firms extend more trade credit than they use; average days of sales outstanding in receivables is 62 while payables are outstanding only 49 days. The sample firms are relatively large, with average assets (*SIZE*) of over $3 billion and median assets (*SIZE*) of $1.068 billion. Ten percent of the firms produce perishable consumer goods, while 45% produce relatively high-tech products.[21] The average firm sells 1.5 times its total assets (net of accounts receivable), and short-term borrowing averages 3.5% of sales.

The effect of the explanatory variables on trade credit policy is examined with cross-sectional *t*-tests of differences between firms with days of sales outstanding below the median (58.6 days), and those with *DSO* above the median. The results are presented in Exhibit 3.

Firms manufacturing goods with a long production time extend more trade credit than low-quality producers; days of sales outstanding are higher for firms with low turnover, which is consistent with Hypotheses 1 and 4. Smaller firms extend more trade credit than larger firms, which is consistent with the product quality theory but inconsistent with traditional theories. The evidence supports Hypothesis 2: firms with established quality reputations extend less trade credit. The evidence supports Hypothesis 3 as well: at least some firms that extend trade credit borrow to do so. This is in contrast to the predictions of the more traditional theories, all of which predict that firms either will purchase on credit or will sell on credit, but not both. Since borrowing to finance trade credit is costly to the firm, it is inconsistent with financial motives but consistent with our explanation. Finally, the evidence supports Hypothesis 4, relating to the time required to observe quality. High-tech firms extend more trade credit with longer terms, while firms producing easy-to-observe perishable products extend less trade credit with shorter terms.

Thus, the evidence is consistent with and therefore supports the product quality theory of trade credit. The evidence is inconsistent with some predictions of the financial, tax and liquidity theories, and we find no support for trade credit as a substitute for institutional lending. The evidence relating to the liquidity theory is inconclusive. Some predictions (firm size and accounts payable policy) are inconsistent with the evidence. The effect of borrowing is less definitive. While firms that borrow extend more trade credit, borrowing may be at a low rate, whereas lending by receivables is assumed to be at a higher rate. Therefore, it is not clear that firms that borrow are less liquid, and we are reluctant to draw inferences concerning the importance of liquidity.

C. Results of Multivariate Tests

More conclusive evidence requires more sophisticated multivariate methods. We estimate *DSO* with a pooled cross-sectional regression. Our results are presented in Exhibit 4.

The results are quite similar to those presented in Exhibit 3. Small firms, those with low turnover, and firms

[21]We verified the common assumption that trade credit is industry-specific by using dummy variables and industry splits. However, our purpose is not to confirm previous knowledge, but rather to provide an explanation for the observed industry differences. Thus, the dummy variables we use, while based on industries, proxy for theoretical implications concerning reputation and product uniqueness.

Exhibit 2. Descriptive Statistics of Variables Measuring Trade Credit Policy, 356 Manufacturing Firms, 1987

	Mean	Standard Deviation	Minimum	25th Percentile	Median	75th Percentile	Maximum
DSO	61.941	29.199	5.869	43.541	58.607	75.720	296.385
TURNOVER	1.514	0.615	0.125	1.069	1.445	1.809	4.611
SIZE	3224.217	7182.045	21.764	392.086	1067.934	2933.197	63904.616
DPO	49.061	33.850	14.676	29.407	39.770	53.749	272.788
STBORROW	0.035	0.054	0.000	0.005	0.023	0.041	0.609
OBSERVE1[a]							
OBSERVE2[a]							

Notes:

DSO (days of sales outstanding) is accounts receivable as a percentage of sales per day. It measures trade credit policy.

[a]Number and percentage of firms in technical and perishable industries are as follows:

	OBSERVE1	*OBSERVE2*
Number	160	34
Percentage	44.9	9.6

Exhibit 3. Univariate Tests of the Difference Between Firm Size, Turnover, Product Uniqueness and Short-Term Liabilities, 356 Firms with Long and Short Credit Terms, 1987

	Low Days Sales Outstanding[a] (42.185)	High Days Sales Outstanding[b] (83.007)	*T*-Statistic of Difference
TURNOVER	1.611	1.392	-3.76***
SIZE[c]	7.248	6.622	-3.98***
DPO[d]	45.055	52.638	2.18**
STBORROW[e]	0.022	0.047	4.58***
OBSERVE1	0.279	0.639	7.41***
OBSERVE2	0.169	0.022	-4.94***

Notes:

**Significant at the 0.05 level.

***Significant at the 0.01 level.

[a]Low days of sales outstanding is defined as *DSO* less than the median of 58.607 days. The average firm in this group has *DSO* of 42.185 days.

[b]High days of sales outstanding are defined as *DSO* greater than the median of 58.607 days. The average firm in this group has *DSO* of 83.007 days.

[c]Firm size (the natural log of total assets less accounts receivable) also measures the creditworthiness of a firm and thus is a predictor variable of the pure financial model and the liquidity model, but with the opposite sign; larger firms extend more trade credit than smaller firms.

[d]Days of payables outstanding (use of trade credit by buyers) also is a predictor variable in the three financial models; there should be a negative association between credit extended as a seller and credit used as a buyer.

[e]Short-term borrowing also proxies for the liquidity of a firm. If correct, we should observe a negative relation between short-term borrowing and trade credit; liquid firms do not need to borrow, but they do extend trade credit.

producing relatively unique products extend significantly more trade credit. Firms finance receivables both by using trade credit and by borrowing. We are able to explain 43% of the variation in trade credit financing.

Finally, we incorporate additional variables specific to the traditional theories. The financial and liquidity theories predict that creditworthy firms should extend trade credit to less creditworthy firms. Creditworthiness is proxied by a firm's credit rating, taken from COMPUSTAT's Standard & Poor's ratings. We aggregate the ratings into three groups, high-, medium- and low-grade debt. Seventeen percent of the 356 firms (61) have a high credit rating (Aaa or Aa), 46% (165) are rated medium-grade (A, Baa) and 37% (130) are rated less than Baa. We create two dummy variables, *RATEHIGH* and *RATEMED*, set equal to one if the firm is in the corresponding group and zero otherwise. We omit the low-rated group. To test the operational theory, which predicts that trade credit is important only when demand is variable, we use the coefficient of variation of sales (the standard deviation of sales over 12 quarters,

Exhibit 4. Multivariate Tests of the Product Quality Theory of Trade Credit: Size, Turnover, Product Uniqueness and Short-Term Liabilities as Predictors of Credit Policy, 356 Firms, 1987

$$DSO_i = \beta_0 + \beta_1 TURNOVER_i + \beta_2 SIZE_i + \beta_3 DPO_i + \beta_4 STBORROW_i + \beta_5 OBSERVE1_i + \beta_6 OBSERVE2_i + e_i .$$

	Coefficient	*T*-Statistic
Constant	84.14	10.83***
TURNOVER	- 7.12	-3.34***
SIZE	- 4.53	-5.59***
DPO	0.18	4.88***
STBORROW	197.85	8.39***
OBSERVE1	13.63	5.46***
OBSERVE2	-17.26	-3.94***
Adjusted R^2: 0.43		
F-Statistic: 45.36***		

Notes:
***Significant at the 0.01 level.

Exhibit 5. Multivariate Tests of the Financial, Tax, Liquidity, Operational and Product Quality Theories of Trade Credit, 356 Firms, 1987

$$DSO_i = \beta_0 + \beta_1 TURNOVER_i + \beta_2 SIZE_i + \beta_3 DPO_i + \beta_4 STBORROW_i + \beta_5 OBSERVE1_i + \beta_6 OBSERVE2_i + \beta_7 RATEHIGH_i + \beta_8 RATEMED_i + \beta_9 VARIABILITY_i + e_i .$$

	Coefficient	*T*-Statistic
Constant	75.647	8.45***
TURNOVER	- 6.312	-2.89***
SIZE	-4.460	-4.39***
DPO	0.166	4.57***
STBORROW	193.689	8.21***
OBSERVE1	13.138	5.28***
OBSERVE2	-18.161	-4.15***
RATEHIGH	2.270	0.52
RATEMED	3.737	1.22
VARIABILITY	27.364	2.65***
Adjusted R^2: 0.436		
F-Statistic: 31.507***		

Notes:
***Significant at the 0.01 level.

normalized by average sales over the period). The average firm has a standard deviation of sales of approximately one-fifth of sales with a coefficient of variation of sales of 0.21. We simultaneously test the full set of specifications suggested by all the theories and present our results on Exhibit 5.

Our evidence again is consistent with the product quality theory of trade credit and inconsistent with the pure financial theory. Smaller firms with lower turnover (longer production cycles), and those requiring more time to observe quality (high-tech) extend more trade credit than larger firms or those where quality is easy to observe (perishable goods). Also contrary to traditional theories, we find that firms borrow or use trade credit to finance receivables. Finally, credit rating appears to have no effect on trade credit policy.[22] Our results are consistent with predictions of the operational theory: firms with variable demand extend significantly more trade credit than firms with stable demand.

IV. Summary and Conclusions

We developed a model of trade credit in which asymmetric information leads good firms to extend trade credit so that buyers can verify product quality before payment. We show that firms producing low-quality goods will sell for cash. The model leads to a set of testable hypotheses. Specifically, we suggest that firms without alternative means of establishing quality reputation, e.g., smaller firms and those producing products that require a long time to verify quality, will offer more trade credit than larger firms with higher turnover and less unique products.

We also review the traditional theories of trade credit, which offer different empirical predictions. The financial, tax and liquidity theories all predict that larger, more creditworthy firms will extend more trade credit and that firms which sell on trade credit will not buy on credit. The

[22]We tested the pure financial theory of trade credit separately and found that higher-rated firms extended less trade credit than lower-rated firms. In addition, we also examined the time series implications of the theory, which predicts that as interest rates rise, larger, more creditworthy firms will offer even more trade credit to smaller firms, which may be closed out of the credit market. To do so, we used data for three three-year periods, ending in 1977, 1982 and 1987. In both 1977 and 1987, interest rates (the commercial paper rate) were relatively low (5.8% and 6.8%, respectively) while in 1982, interest rates averaged 11.9%. Large firms are defined as those with assets above the median. We tested for a difference in the *DSO* of large firms between the time periods using a two-sample *t*-test. Between 1977 and 1982, *DSO* insignificantly increased from 55.7 to 56.4 (*t*-statistic of 0.77), while between 1982 and 1987, average *DSO* significantly increased from 56.1 to 61.7 (*t*-statistic of 5.0). The increase between 1977 and 1987 is also statistically significant (*t*-statistic of 4.9). While trade credit terms expand over time, in years when interest rates rise, *DSO* declines, which is contrary to Schwartz's prediction.

operational theory predicts that firms with variable demand will extend more trade credit than firms with relatively stable demand.

We empirically test the alternative theories using a large sample of manufacturing firms. We find evidence consistent with our model supporting differences in trade credit both across and within industries. Specifically, we find that smaller firms, those that have a longer production lead time and firms producing products where quality requires a longer time to assess extend more trade credit. The evidence suggests that producers may increase the implicit cost of extending trade credit by financing their receivables through payables and short-term borrowing. We also find that, consistent with the operational theory, firms with more variable demand extend more trade credit than firms with stable demand. The evidence is inconsistent with the pure financial and liquidity theories.

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