

Trade Credit: Theories and Evidence

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Firms may be financed by their suppliers rather than by financial institutions. There are many theories of trade credit, but few comprehensive empirical tests. This article attempts to fill the gap. We focus on small firms whose access to capital markets may be limited and find evidence suggesting that firms use more trade credit when credit from financial institutions is unavailable. Suppliers lend to constrained firms because they have a comparative advantage in getting information about buyers, they can liquidate assets more efficiently, and they have an implicit equity stake in the firms. Finally, firms with better access to credit offer more trade credit.

Trade credit is the single most important source of short-term external finance for firms in the United States.¹ Why do industrial firms extend trade credit when more specialized financial institutions such as banks could provide finance? There are many

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¹ Rajan and Zingales (1993) report that accounts payable amounted to 15% of the assets for a sample of nonfinancial U.S. firms on Global Vantage while debt in current liabilities accounted for just 7.4%.

theoretical explanations for trade credit: Trade credit may provide access to capital for firms that are unable to raise it through more traditional channels. Suppliers may be better than specialized financial institutions in evaluating and controlling the credit risk of their buyers. If so, trade credit may be a way for firms with better access to credit markets to intermediate finance to firms with less access to credit markets. Alternatively, trade credit may allow suppliers to price discriminate using credit when discrimination directly through prices is not legally permissible. Finally, trade credit may be useful in reducing transaction costs or in providing assurances about the quality of the supplier's products. Unfortunately, there is very little systematic evidence about why trade credit is extended or which firms are the largest providers or users of trade credit. In this article, we shed some light on these issues.

The problem in testing theories of trade credit thus far has been the paucity of data. Databases like Compustat do not have the detail needed to test the nuances of the various theories that serve to distinguish them. In this article, we use a more detailed database compiled by the National Survey of Small Business Finance (NSSBF). This dataset focuses on small firms, which are more likely to face constraints on their ability to raise capital.

We find that suppliers appear to have some advantage in financing growing firms, especially if their credit quality is suspect. We conjecture three potential reasons for this. First, the evidence suggests these firms may be a source of future business, and suppliers are more willing to provide credit in anticipation of capturing this business. Second, suppliers may obtain the information they need at low cost from product market transactions, and perhaps from other suppliers. The information that suppliers use in monitoring and controlling repayment seems to be different from that used by financial institutions, perhaps because the nature of the credit is very different. Third, suppliers appear to rely on their ability to repossess and sell the goods against which credit has been granted.

The rest of the article is organized as follows. In Section 1, we flesh out the empirical implications of what we believe are the most important theoretical explanations of trade credit. In Section 2, we describe the data. Section 3 examines the determinants of trade credit granted by a firm, while Section 4 examines who receives credit. We conclude with a discussion of the results and suggestions for future research.

1. Trade Credit: Theories

We start with a brief description of the theories that have been proposed to explain the existence and use of trade credit. This list is not meant to be comprehensive. Rather, it reflects what we believe are

the more plausible theories in the literature and the ones upon which our data can shed light.

1.1 Financing advantage theories of trade credit

The supplier may have an advantage over traditional lenders in investigating the credit worthiness of his clients, as well as a better ability to monitor and force repayment of the credit. This may give him a cost advantage over financial institutions in offering credit to a buyer [see Schwartz (1974) for an early exposition of the financing advantage theory of trade credit]. There are at least three sources of cost advantage.

1.1.1 Advantage in information acquisition. The supplier may visit the buyer's premises more often than financial institutions would. The size and timing of the buyer's orders also give him an idea of the condition of the buyer's business. The buyer's inability to take advantage of early payment discounts may serve as a trip wire to alert the supplier of a deterioration in the buyer's creditworthiness.² While financial institutions may also collect similar information, the supplier may be able to get it faster and at lower cost because it is obtained in the normal course of business.

1.1.2 Advantage in controlling the buyer. It may be in the nature of the goods being supplied that there are few economical alternative sources other than the supplier. If so, the supplier can threaten to cut off future supplies in the event of borrower actions that reduce the chances of repayment. This threat may be especially credible if the buyer accounts for a small portion of the supplier's sales. By contrast, a financial institution may have more limited powers; the threat to withdraw future finance may have little immediate effect on the borrower's operations. Furthermore, the financial institution's ability to withdraw past finance may be constrained by bankruptcy laws.

1.1.3 Advantage in salvaging value from existing assets. If the buyer defaults, the supplier can seize the goods that are supplied. The more durable the goods supplied, the better collateral they provide and the greater the credit the supplier can provide [see Mian and Smith (1992)]. Financial institutions can also reclaim the firm's assets to pay off the firm's loan. However, if the supplier already has a network for selling its goods, its costs of repossessing and resale will be lower than that of an institution. The advantage of suppliers over financial

² Theories of trade credit based on the seller having superior information to financial institutions or the seller using trade credit terms to sort buyers include Smith (1987), Brennan, Maksimovic and Zechner (1988), Biais, Gollier, and Viala (1993).

institutions will vary cross-sectionally depending upon the type of goods the supplier is selling and how much the customer transforms them. The less the goods are transformed by the buyer, the greater the advantage the supplier will have over financial institutions in finding an alternative buyer.³

1.2 Price discrimination through trade credit

Trade credit may be offered even if the supplier does not have a financing advantage over financial institutions because credit may be used to price discriminate [see Meltzer (1960), Schwartz and Whitcomb (1979), Brennan, Maksimovic and Zechner (1988), and Mian and Smith (1992)]. Since credit terms are usually invariant to the credit quality of the buyer, trade credit reduces the effective price to low-quality borrowers.⁴ If this is the most price elastic segment of the market, then trade credit is an effective means of price discrimination. A natural reason why this segment's demand may be more price elastic is because it is typically credit rationed. If so, trade credit both lowers the effective price of the good and permits this segment to express its demand.

Another way of seeing this is to note that firms with a high margin (between sales and variable costs) for their product clearly have a strong incentive to make additional sales, but without cutting the price to existing customers. Since their profit on the next unit is higher, they would be willing to incur a positive cost to sell an additional unit, so long as it does not affect their previous sales. Under the assumption that antitrust laws prevent direct price discrimination, high-priced trade credit may be a subsidy targeted at risky customers. Creditworthy customers will find the trade credit overpriced and repay it as soon as possible. On the other hand, risky customers will find it worthwhile to borrow because trade credit may still be cheaper than the other sources they have access to.

A related version of this theory is that the supplier does not discriminate in favor of the risky customer solely because the customer's demand is more elastic in the short run. Rather, the supplier may have a long-term interest in the survival of the customer firm. This is especially true if the supplier has no potential substitutes for the customer. The supplier then factors in not only the net profit mar-

³ Of course, if there are multiple creditors including financial institutions, bankruptcy laws may prevent a creditor from seizing particular goods unless the sale is on consignment, in which case this advantage may be irrelevant.

⁴ Petersen and Rajan (1994) find that once the decision to grant credit has been taken, the credit terms seem to follow industry practice. They are usually not tailored to the particular borrower. Also see Smith (1980).

gin on current sales but also the present value of the profit margins on future sales when deciding whether to help the customer with credit. In other words, the supplier may want to protect the value of its implicit equity stake in the customer by providing it temporary short-term financing.⁵

1.3 Transactions costs theories

Trade credit may reduce the transaction costs of paying bills [Ferris (1981)]. Rather than paying bills every time goods are delivered, a buyer might want to cumulate obligations and pay them only monthly or quarterly. This will also enable an organization to separate the payment cycle from the delivery schedule. There are other versions of the transaction cost theory. There may be strong seasonalities in consumption patterns for a firm's products. In order to maintain smooth production cycles, the firm may have to build up large inventories. This has two costs: the costs of warehousing the inventory and the costs of financing it. Of course, the firm could lower prices in order to effect early sales. But there may be menu costs in doing this, as well as a loss in discretionary ability. By offering trade credit selectively, both across customers and over time, the firm may be able to manage its inventory position better [see, e.g., the classic Harvard Business School case, Harrington Corporation. Also see Emery (1987)]. The firm can thus reduce warehousing costs, especially if its customers have a better ability to carry inventory.

2. Data and Econometric Model

The above theories are hard to test without detailed firm-level data. Fortunately, the National Survey of Small Business Finances which we use contains detailed cross-sectional information on small firms. While these firms are much smaller than the typical firm on a database such as Compustat, some of the above theories are most applicable to small firms. A shortcoming of this survey is that with the exception of sales figures, all other data are available for only one year. This will limit the scope of our investigation. For instance, many of the testable implications of the transaction cost hypotheses pertain to the time series. To the extent that we do not have the data to test these theories, they should be considered part of the null.

⁵ This argument is conceptually the same as that made in Petersen and Rajan (1995). In that model, banks in monopolistic credit markets were willing to subsidize borrowers with low interest rates since they expected to reap a return in the future by charging above-market rates to the firms that survived.

2.1 Sample Description

The National Survey of Small Business Finances was conducted in 1988–1989 under the guidance of the Board of Governors of the Federal Reserve System and the U.S. Small Business Administration. It targeted nonfinancial, nonfarm small businesses that were in operation as of December 1987.⁶ Financial data were collected only for this fiscal year. The sample was stratified by census region (Northeast, North Central, South, and West), urban/rural location [whether the firm was located in a Metropolitan Statistical Area (MSA)], and by employment size [less than 50 employees, 50–100 employees, more than 100 employees, and less than 500 employees (the maximum size in the sample)]. The stratification was done to ensure that large and rural firms are represented in the sample. The response rate was 70% to 80%, depending upon the section of the questionnaire considered.⁷

There are 3404 firms in the sample, of which 1875 are corporations (including S corporations) and 1529 are partnerships or sole proprietorships. These firms are small. The median firm has a book value of assets of \$130,000 and sales of \$300,000. Nearly 90% of these firms are owner managed; 12% are majority owned by women and 7% by minorities. Nearly 28% of the firms in our sample are in the service industry. These firms are the smallest when measured on the basis of the book value of assets. Another 27% of the firms are in the retail trade industry. The largest firms on the basis of book assets are the manufacturing firms. Twelve percent of our firms are in the manufacturing industry.

One of the virtues of the NSSBF data is that it contains details that are not normally available in more commonly used datasets such as Compustat. The dataset not only includes information from the firm's balance sheet and income statement, but it is also a rich source of information on the current financing of the firm as well as the history of its interactions with financial institutions (i.e., length of relationships with financial institutions and whether the firm applied and was turned down for a loan in the last year). Firms report all outstanding financial obligations to financial institutions, nonfinancial firms, and individuals. Thus we know whether the firm has a mortgage, the unused portion of its line of credit (assuming it has one), and the interest rate on the firm's most recent loan. The dataset also reports some information about the type of financial institutions providing the firm with capital. For example, we know how long the firm has

⁶ Firms involved in the agriculture, forestry, and fishing industry, finance and insurance underwriting, or real estate investment trusts were excluded from the survey.

⁷ Firms were initially sent a series of worksheets that listed the financial information which the questionnaire would collect. The worksheets were followed by a telephone interview.

had a relationship with the financial institution and the services the institution provides.

2.2 Estimation strategy

We will attempt to verify some of the implications of the theories described earlier by examining the determinants of a firm's usage of trade credit. In addition to the standard proxies for trade credit usage, accounts receivable, and accounts payable, the NSSBF data provide us with proxies hitherto unavailable on a systematic basis. Even so, the lack of detailed data will necessitate some caution in interpreting the results.

When we view the firm as a supplier, its accounts receivable are a proxy for how much it lends its customers. When we view the firm as a customer, its accounts payable are its borrowing from its supplier. Thus we will examine both sets of trade credit relationships a firm has and treat the firms in our dataset first as lenders (suppliers) and then as borrowers (customers).

Although we refer to the level of the firm's accounts receivable as a proxy for how much it decides to lend, the level is not determined solely by the firm. A firm's accounts receivables are simultaneously determined by the firm's willingness and ability to extend credit, as well as the ability or desire of its customers to repay the amount when due. The former could be thought of as the supply of credit by the firm and the latter as the demand for credit by the customer (see Figure 1). When we regress a firm's accounts receivable on its financial characteristics in Section 3, we have not estimated a supply curve. The estimates are reduced form coefficients that include both supply and demand effects. For example, if we find that larger firms have higher accounts receivable, we could interpret this to mean that larger firms have better access to capital markets. Since they are less credit constrained they offer more credit to their customers (a supply effect). Alternatively, large suppliers may sell to small start-up firms with little access to capital markets. In this case, the credit demand by the customers of large firms is high. If they tend to repay their trade credit later than average, this would explain the higher level of accounts receivables for large firms. The ideal way to distinguish between these two effects (and possibly others) is to include information about both the supplier and customer in the model. In the absence of data on the customer, we cannot interpret the coefficients as structural. We still think it is possible to learn from the results, even given this problem.

The process of estimating trade credit borrowing by our firm is perhaps more informative (Section 4). The level of accounts payable is again determined simultaneously by both the credit extended to the firm by its suppliers as well as our firm's demand for funds. While

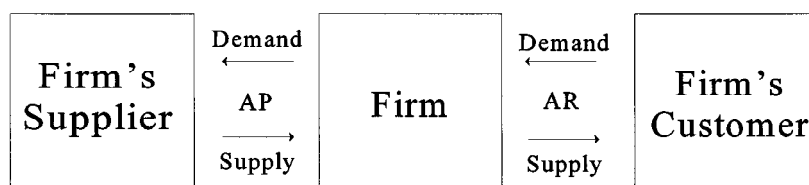


Figure 1
The trade credit relationships

The amount of trade credit extended between the firm and its suppliers will appear as the accounts payable on the balance sheet of the firm. The amount of trade credit extended between the firm and its customers will appear as accounts receivable on the balance sheet of the firm.

we do not have information on the firm's suppliers, we have a proxy for the quantity of credit supplied to the firm which is distinct from the firm's accounts payable. This is the fraction of the firm's annual purchases that are made on account. To understand why this may allow us to distinguish demand factors from supply factors, we have to consider credit terms in more detail.

Credit terms typically quote a discount date, a due date, as well as the amount of discount for payment by the discount date. For example, firms in the retail business quote trade credit terms as 2–10 net 30 [Smith (1987)].⁸ This means the customer receives a 2% discount if their bill is paid within 10 days (the discount date) or they may pay the full amount by day 30 (the due date). These terms imply an escalating schedule of penalties. The customer gets what is effectively an interest-free loan until the tenth day. If the customer does not pay by the discount date, but pays on day 30, it is effectively borrowing over the next 20 days at an annual rate of 43.5%. If it does not pay by the due date, additional sanctions may be applied such as the eventual cutoff of supplies. These sanctions could raise the effective interest rate even higher.

Since there is no cost to accepting credit (at least until the discount date), the fraction actually purchased on account is relatively close to the fraction that is offered on account. This is the amount of credit voluntarily offered by suppliers. Thus when estimating the amount borrowed from suppliers, we will proceed in two steps. We first estimate the fraction of goods offered on credit to the firm, based on its characteristics. These estimates can then be used to predict the supply of trade credit to the firm. The second step is to note that the firm's accounts payable are a function both of the supply of trade credit and how long the firm takes to repay the debt. The former is proxied

⁸ We do not know the actual discount offered, although we do know the fraction of credit purchases that have a discount associated with them.

for by the predicted value from the first regression, while the other variables in the regression control for demand factors. Holding the predicted supply of credit constant, greater demand for credit will appear as later payment and thus a higher level of accounts payable by our firm. We also use instrumental variables to estimate this equation and obtain very similar results. Whether we are able to distinguish the demand from the supply function is an empirical question we address below.

2.3 Data description: The use of trade credit by small and large firms

It is instructive to compare the use of trade credit by firms in our sample to the use of trade credit by larger firms in the much more widely used Compustat dataset. We calculate the accounts payable and accounts receivable to sales ratios by seven broad industry classifications for both our sample of small firms (NSSBF) and a sample of large firms (Compustat). To reduce differences induced by time we use Compustat data from 1987. The ratios are reported in Table 1. Small firms uniformly use less trade credit than the large firms. Firms in the NSSBF have accounts payable equal to only 4.4% of their sales, whereas for Compustat firms, accounts payable comprise 11.6% of their sales.⁹

Not only do the small firms borrow less through trade credit, they also extend less trade credit. The small firm accounts receivable:sales ratio is 7.3% versus 18.5% for Compustat firms. The difference in medians is similar (3.8% versus 16.1%). The greater use of trade credit by larger firms that is apparent in the aggregate numbers is also apparent in each of the industries. If small firms are more capital constrained we would expect them to extend less trade credit (smaller accounts receivables), but also borrow more through trade credit (have higher accounts payable). However, their desire to borrow through trade credit may not be matched by suppliers' willingness to lend. An analysis of which effect dominates is best left to the regression analysis. A final observation from Table 1 is that trade credit is not a net source of finance for most firms, large or small. Across the sample, trade credit is a net source of financing for about a third of the firms. The retail industry is the one exception. In this industry, trade credit is a net source of funds for over half the firms. The retail sector's low level of

⁹ These averages are calculated including firms that report zero accounts payable (see Table 1). The fraction of firms with zero accounts payable is also reported in the table. Instead of standardizing by sales, we could have standardized by costs of goods sold. Using this standardization, small firms still have significantly lower levels of accounts payable. Accounts payable are 9.0% of cost of goods sold for the small firms and 18.9% of cost of goods sold for the large firms.

Table 1
Accounts payables and receivables to sales ratios

Industry	Accounts payable/sales			Accounts receivable/sales		
	Mean	Median	% Zero	Mean	Median	% Zero
Panel A: Small firms ^a						
Mining	6.1	4.6	23.1	9.9	6.9	30.8
Construction	5.4	2.5	25.7	10.4	7.8	14.8
Manufacturing	6.5	4.2	11.7	11.8	10.0	9.8
Transportation/utilities	3.8	1.9	31.5	8.1	6.5	17.6
Wholesale trade	7.0	3.8	15.6	8.1	7.0	6.2
Retail trade	3.9	1.7	26.6	3.0	0.4	39.6
Services	2.7	0.0	51.9	8.0	3.5	34.2
Total	4.4	1.8	30.9	7.3	3.8	26.5
Panel B: Large firms ^b						
Mining	25.2	17.5	0.5	28.7	21.7	2.0
Construction	17.0	8.3	0.0	15.8	16.4	23.7
Manufacturing	9.8	7.4	0.4	19.1	17.0	0.6
Transportation/utilities	14.3	8.6	1.2	16.2	14.1	2.6
Wholesale trade	12.5	8.6	2.0	15.5	14.0	0.9
Retail trade	8.6	6.7	0.8	7.3	2.3	6.2
Services	10.6	6.5	1.1	22.4	19.4	3.7
Total	11.6	7.6	0.7	18.5	16.1	2.3

^aThis table is based on the National Survey of Small Business Finance. Firms in the agricultural (SIC 100–999) and financial sectors (SIC 6000–6999) were excluded. Ratios are expressed as percents.

^bThis table is based on the Compustat database. Firms in the agricultural (SIC 100–999) and financial sectors (SIC 6000–6999) were excluded. Ratios are expressed as percents.

accounts receivable may be the result of technological changes that have shortened the time it takes to collect (credit card) receivables. The growth of credit card usage will shrink the accounts receivables for retail firms. Accounts receivable have fallen monotonically as a fraction of sales from 9.4% in 1970 to 8.0% in 1980 to 7.3% in 1987.

We now examine the use of trade credit by small firms in greater detail. Even in our sample of small firms, borrowing on and extension of trade credit increases with firm size. Table 2 panel A shows the median accounts receivable:sales ratio when firms are grouped by industry and size. In all industries, the ratio increases with firm size. The median accounts payable:sales ratio also rises with firm size across industries (see Table 2, panel B). Thus, within the NSSBF sample, and between the NSSBF and Compustat sample, we find larger firms borrow and extend more trade credit.

The firm's purchases on account will be used as a measure of the credit it is supplied. We define annual credit purchases as the product of cost of goods sold and the fraction of purchases made on credit. We normalize this by the value of assets—because we want to draw a correspondence to leverage which is usually measured in terms of assets—and report medians in Table 2, panel C. There appears to be a weak positive relationship between credit purchases and size. Be-

Table 2
Trade credit offered and used by firms (by size and by industry)

Book value of assets (\$1000)	Asset percentile	Industry						
		Construction and mining	Manufacturing	Transportation	Wholesale (durables)	Wholesale (nondurables)	Retail	Services
Panel A: Accounts receivable ^a								
Less than 15	0-10	0.00 (42)	0.00 (17)	0.00 (5)	0.00 (7)	0.02 (5)	0.00 (54)	0.00 (133)
15-46	10-25	0.05 (86)	0.02 (30)	0.00 (7)	0.05 (18)	0.04 (12)	0.00 (147)	0.02 (167)
46-130	25-50	0.07 (96)	0.08 (52)	0.03 (28)	0.06 (36)	0.06 (24)	0.00 (288)	0.04 (244)
130-488	50-75	0.09 (102)	0.10 (95)	0.07 (33)	0.08 (47)	0.06 (36)	0.01 (236)	0.05 (215)
488-2293	75-90	0.12 (54)	0.12 (86)	0.08 (22)	0.09 (43)	0.05 (40)	0.01 (120)	0.09 (83)
Over 2293	90-100	0.17 (33)	0.12 (106)	0.10 (13)	0.11 (25)	0.06 (28)	0.01 (57)	0.14 (42)
Panel B: Accounts payable to assets ^b								
Less than 15	0-10	0.00 (42)	0.00 (17)	0.00 (5)		0.02 (12)	0.00 (54)	0.00 (133)
15-46	10-25	0.02 (86)	0.02 (30)	0.00 (7)		0.12 (30)	0.02 (147)	0.00 (167)
46-130	25-50	0.05 (96)	0.05 (52)	0.00 (28)		0.07 (60)	0.03 (288)	0.00 (244)
130-488	50-75	0.08 (102)	0.11 (95)	0.02 (33)		0.12 (83)	0.07 (236)	0.00 (215)
488-2293	75-90	0.14 (54)	0.14 (86)	0.04 (22)		0.16 (83)	0.09 (120)	0.03 (83)
Over 2293	90-100	0.18 (33)	0.12 (106)	0.05 (13)		0.17 (53)	0.06 (57)	0.03 (42)
Panel C: Credit purchases to assets ^c								
Less than 15	0-10	2.54 (45)	2.01 (12)	0.00 (2)		2.99 (9)	1.31 (28)	0.00 (70)
15-46	10-25	1.38 (68)	1.10 (18)	0.00 (4)		1.77 (21)	1.02 (98)	0.00 (117)
46-130	25-50	1.36 (82)	0.91 (47)	0.00 (18)		1.26 (49)	1.24 (200)	0.00 (169)
130-488	50-75	0.98 (83)	1.25 (82)	0.00 (29)		2.07 (72)	1.36 (195)	0.00 (158)
488-2293	75-90	1.55 (47)	1.42 (70)	0.00 (23)		2.00 (75)	1.43 (109)	0.00 (68)
Over 2293	90-100	1.85 (27)	1.33 (89)	0.00 (11)		2.03 (48)	1.85 (49)	0.00 (41)

^aThis panel describes the median accounts receivable: sales ratio for firms in the NSSBF. The number of firms in each cell is reported in parenthesis.

^bThis panel describes the median accounts payable to assets ratio for firms in the NSSBF. The number of firms in each cell is reported in parenthesis.

^cCredit purchases are defined as the product of cost of goods sold and the fraction purchased on account. The panel describes the median purchases: assets ratio for firms in the NSSBF. The number of firms in each cell is reported in parenthesis.

cause of the nature of their business, both transportation and service firms make very few purchases, hence their credit purchases are also small.

3. Who Offers Credit?

3.1 The determinants of accounts receivable

We now test how the level of accounts receivable depends on the characteristics of the supplier. All the above theories would predict that firms that are more creditworthy and have greater observed access to institutional credit should offer more finance. The data confirms this in large measure, though there is some surprising new evidence. The use of trade credit as a means of price discrimination also suggests that the amount of credit offered should increase in the firm's margins. This is supported by the data.

3.1.1 The supplier's access to financing. In Table 3, we regress the firm's accounts receivable:sales ratio against proxies for the firm's own access to financing, the firm's characteristics, and its incentive to price discriminate. A summary of the data is reported in Table 4. Since the firm's ability to extend credit will depend upon its ability to raise funds in capital markets, we must control for the availability and cost of the firm raising capital. Both firm size and firm age are proxies for the credit worthiness of a firm. Typically, larger firms borrow more even though they have higher cash flows and fewer growth opportunities. This suggests that they are more creditworthy. The age of a firm indicates how long it has survived. It is an important proxy, especially in this sample, for firm quality and the firm's reputation with potential lenders.¹⁰ Both variables should have a significant influence on the amount of credit extended by the firm.

This is indeed the case (see Table 3, column 1). A firm with \$670,000 in assets (the 75th percentile) extends an additional 3.3% more of its sales in the form of accounts receivables as compared to a firm with \$55,000 in assets (the 25th percentile). The effect is economically large for the median accounts receivable:sales ratio is 3.9% (see Table 4).

¹⁰ In addition to being better credit risks themselves, older firms may also know more about their customers. In this case, older firms would face less risk in extending credit to their (long time) customers than younger firms. To test this hypothesis, we can separately control for the firm's age and the firm's age under current management. Only the latter variable is included in Table 3. A firm's age under current management is the empirically important variable in predicting the firm's access to capital [see Petersen and Rajan (1994)]. Thus, including the age of the firm can act as a proxy for the maximum amount of time the firm may have known its customers. Holding the time under current management constant and increasing the age of the firm lowers the firm's accounts receivable, which is inconsistent with this alternative hypothesis.

Table 3
The determinants of accounts receivable

Independent variable	I	II	III	IV ^a	V ^b
Log(book value of assets)	.013* (.001)	.013* (.001)	.014* (.001)	.012* (.001)	.010* (.003)
Log(1 + firm age) (in years)	.006* (.002)	.024** (.010)	.025* (.010)	.013 (.009)	.033 (.021)
Log(1 + firm age) ² (in years)		-.004*** (.002)	-.004** (.002)	-.003 (.002)	-.007 (.004)
Maximum available line of credit/sales	.027* (.006)	.027* (.006)	.026* (.006)	.021* (.005)	.103** (.051)
Net profits/sales	-.031* (.010)	-.033* (.010)			
Net profits/sales if positive, zero otherwise			-.004 (.013)	-.009 (.012)	.023 (.042)
Net profits/sales if negative, zero otherwise			-.101* (.021)	-.105* (.020)	-.153* (.054)
Percent sales growth (86–87) if positive, zero otherwise	.032* (.010)	.033* (.010)	.033* (.010)	.004 (.009)	-.002 (.027)
Percent sales growth (86–87) if negative, zero otherwise	-.051* (.009)	-.053* (.009)	-.048* (.009)	-.030* (.008)	-.039 (.028)
Gross profit margin/sales	.016** (.008)	.060** (.028)	.056** (.028)	.117* (.030)	.201** (.079)
(Gross profit margin/sales) ²		-.043*** (.027)	-.045*** (.026)	-.118* (.030)	-.206** (.096)
Firm is in MSA (0,1)	.014* (.004)	.014* (.004)	.014* (.004)	.007** (.003)	.012 (.009)
Wholesaler of durable goods (0,1)					.001 (.009)
Number of observations	1805	1805	1805	1805	277
Adjusted R ²	0.141	0.144	0.150	0.315	0.154

The dependent variable is the accounts receivable:sales ratio reported by the firm. The coefficients are estimated using ordinary least squares. Standard errors are in parentheses. Each regression has a constant whose coefficient is not reported. Firms in the financial industry (SIC 6000–6999) and the service industry (SIC 7000–8999) are excluded unless otherwise stated. When the distribution of a variable was highly skewed for high values, we recoded the highest percent of values to the 99th percentile of the distribution. Similarly if it was highly skewed for low values, we recoded the lowest percent of values to the 1st percentile of the distribution. These variables include accounts receivable to sales, net profits to sales, sales growth, and gross profit margin to sales.

^a40 two-digit SIC indicators are included in addition to the constant.

^bIncludes only wholesalers (SIC codes 5000–5199).

*, **, ***Coefficient significantly different from zero at the 1%, 5%, and 10% level, respectively.

Table 4
Summary statistics

Variables	Mean	Median	Standard deviation
Accounts receivable:sales ratio	0.066	0.039	0.083
Log(book value of assets)	12.18	11.96	1.93
Log (1 + firm age) (in years)	2.35	2.39	0.88
Maximum available line of credit/sales	0.06	0.00	0.09
Net profit/sales	0.10	0.05	0.23
Percent sales growth (86–87) if positive, zero otherwise	0.26	0.07	0.59
Percent sales growth (86–87) if negative, zero otherwise	–0.04	0.00	0.11
Gross profits/sales	0.40	0.35	0.25

Older firms also extend more credit to their customers. However, the magnitude of the coefficient is smaller. Increasing firm age from 0 to 10 years old (the minimum to the median) raises the firm's accounts receivables by 1.4% of sales. The problem is we have not allowed for sufficient non-linearity in the relationship. Additional years add significantly to a firm's reputation early in its life, but have little effect later. When we include the square of the log of firm age (see Table 3, column 2), both age terms are statistically significant. Accounts receivable first increase with age and eventually fall. Accounts receivable peak when a firm is about 19 years of age. Once correctly specified, the effect of age doubles. When a firm matures from a startup to a 10-year-old firm, the credit it extends through accounts receivable rises by 3.5% of its sales. However the decrease in accounts receivable with age is not nearly as dramatic.¹¹

While the above two variables proxy for the firm's access to external financing, we also have data on the maximum amount that can be drawn on the firm's line of credit (if it has one). This is strongly positively correlated with the amount of accounts receivable that a firm extends ($\beta_{\text{Max Line of Credit}} = 0.027$, $t = 4.8$). Interestingly, when we break this amount into the portion that has been drawn down already and the portion that is as yet untapped (regression not reported), the amount that has already been drawn down has an estimated coefficient of 0.028, while the amount that is unused has an estimated coefficient of 0.017. Thus the line of credit does appear, in part, to be directly financing accounts receivable.¹²

Surprisingly, net income, which is a proxy for internal cash generation, is negatively correlated with accounts receivable (see Table 3, column 1). We would expect that firms with more internal cash—higher profits—would be able to extend more credit to their customers. Conditioning on the other variables, however, profitable firms offer less trade credit. We will offer an explanation of this finding shortly.

¹¹ Another explanation of the eventual decline in credit offered with firm age is that the oldest firms in our sample are fundamentally different. Recall that to be in the sample, the firm has to have less than 500 employees. Thus, if a firm grew enough, it would not be in our sample. The really old firms are likely to be an adversely selected sample of old firms. Since they may also have higher costs of credit, sample selection and the cost of credit is enough to explain the age effect. We are careful to ensure that the results we highlight hold even when we restrict the sample to firms below 10 years of age where the effect of this selection bias is likely to be small.

¹² Analogous to this finding, Calomiris, Himmelberg, and Wachtel (1995) find that firms issuing commercial paper also offer more trade credit. So firms with access to short-term financing offer more short-term credit. We also include accounts payable (as a measure of trade credit borrowing) and the fraction of purchases made on credit (as a measure of the supply of trade credit). The coefficient estimates are positive and significant ($\beta_{\text{Payables}} = 0.056$, $t = 5.01$, $\beta_{\text{Purchases}} = 0.0002$, $t = 2.9$). The positive coefficients on payables and credit purchases are consistent with the idea that firms with greater access to financing extend more credit. However, the direction of causality between payables and receivables is debatable.

3.1.2 Economic shocks. Changes in a firm's sales may indicate shocks to the firm's operations and help us explain the coefficient on net profits. We include sales growth multiplied by indicators if positive and negative. Firms that have had positive sales growth offer slightly more receivables ($\beta = 0.032$, $t = 3.2$). The coefficient on positive sales growth is economically small.

Firms that have seen their sales decline, however, find their accounts receivable:sales ratios increase significantly ($\beta = -0.051$, $t = -6.0$). A firm whose sales drop by 30% (the average change for firms with sales declines), increases its accounts receivable:sales ratio by about 3% of sales.¹³ Given that accounts receivable is short-term credit—the days receivable outstanding is less than 30 days on average—it is unlikely that the downward stickiness is because credit is offered before the collapse in sales and is not yet due. Rather, firms in trouble may use the extension of credit to attempt to maintain their sales. This leads to a possible explanation of why profits are negatively correlated with receivables. When we split profits up into positive profits and losses (Table 3, column 3), only losses are significantly negatively correlated with accounts receivable ($\beta = -0.10$, $t = -4.8$). Thus, firms making losses tend to extend more credit.

To explore this further, we separate losses into losses if the firm has positive sales growth and losses if the firm has negative sales growth. The coefficient on the former is almost twice as large ($\beta = -0.126$, $t = -4.579$) as the latter ($\beta = -0.072$, $t = -2.289$). So firms that grow fast (and generate losses in the process) seem to extend more credit and perhaps “buy” sales. But firms in distress (negative sales growth and negative income) also offer more trade credit. Some of the increase in credit extended by distressed firms may be involuntary. It is possible that debtors are less willing to repay a distressed firm. Since repayment is enforced by the threat of cutting off future supplies, such threats are less credible when the supplier is distressed. Also, a distressed firm may be less capable of legal action to recover its dues. The delay in repaying a distressed firm is a potential cost of financial distress that deserves further study.¹⁴

3.1.3 Price discrimination—trade credit as a strategic tool. Although our focus so far has been on whether a firm has the ability to

¹³ This does not necessarily imply that the level of credit extended increases. Consider a firm whose initial accounts receivable:sales ratio is 7.3%—the average for firms in our sample. The regression results predict that a drop of 30% in the firm's sales is associated with the accounts receivable: sales ratio rising to 8.8%. Therefore, after sales drop by 30%, accounts receivable are now $0.103 \times 0.700 \times$ initial sales, that is, 6.2% of initial sales. Accounts receivable have fallen, but only 15%.

¹⁴ We also check that all our prior results are not driven only by distressed firms. We define a firm to be distressed if it has negative sales growth and negative net income. Dropping these firms or dummifying them out does not qualitatively affect the coefficient estimates.

finance trade credit, our data allow us to test the price discrimination theory. It predicts that trade credit should be positively related to a firm's gross profit margin. The larger a firm's gross profit margin the greater its incentive to sell, and if necessary, finance an additional unit. We find a positive relationship (see Table 3, column 1) when only the gross profit margin is included ($\beta = 0.016$, $t = 2.0$). The correct specification is once again nonlinear (see Table 3, column 2). When the gross profit margin squared is included, the coefficient on the linear term rises from 0.016 to 0.060 ($t = 2.1$), while the coefficient on the squared term is -0.043 ($t = -1.7$). This implies that accounts receivable increase with gross profit margins until they reach about 70%. This is about the 90th percentile for gross margins in our sample. The effect is also economically sizable. An increase in gross margin from 0% to 35% (the median) increases accounts receivable by about 1.5% of assets.¹⁵

3.2 Robustness checks

At least part of the pattern of trade credit can be explained by differences in historical practices across industries [see Dun and Bradstreet (1970)]. To test whether our results are simply picking up historical accident, it is constructive to see whether they survive the inclusion of more-detailed industry dummies. In Table 3, column 4, we include 40 two-digit SIC dummies. This is the finest classification of industry contained in our data. Not surprisingly, the explanatory power of the regressions rises. However, the relationships discussed above are qualitatively unchanged. The economic significance of the gross profit margin is even greater when we control for industry. This is reassuring since gross profit margins differ significantly across industries and could therefore have proxied for unmeasured industry effects.

We have a large number of wholesalers in the sample. This group is further divided into those who sell durables and those who sell nondurables. By restricting the regression to this relatively homogenous group, we can check if the above results hold within group also. As the estimates in column 5 suggest, this is indeed the case.¹⁶

¹⁵ We have argued earlier that firms with higher cashflow should be able to extend more credit. The gross profit margin is not merely a proxy for cashflow. Net income which is included in the regression is a better proxy. In fact, the correlation between the two is only 0.28.

¹⁶ This subsample also enables us to test the "quality guarantee" theory. By this we refer to the argument that trade credit may serve as a warranty for product quality. Firms without reputations in the product market can attest to the quality of their goods by bearing the cost of financing them until such time as the buyer can ascertain quality for himself [see Smith (1987) and Long, Malitz, and Ravid (1994)]. This would imply that firms without a good reputation—that is, smaller and younger firms—offer more credit and that firms producing durables offer more credit than firms producing perishables. We include an indicator for wholesalers of durables. The quantity of credit offered by these merchants is both statistically and economically insignificantly different from those selling nondurables ($\beta = 0.001$, $t = 0.1$).

We also include an indicator if the firm is located in an MSA (regression not reported). A firm in an MSA extends significantly more credit ($\beta = 0.014$, $t = 3.8$). A potential explanation is that institutional lending is less available in the competitive metropolitan areas [see Petersen and Rajan (1995)] and therefore trade credit substitutes for it. Alternatively, the kind of information trade creditors obtain is less valuable in rural areas where everyone knows everybody else's business. Another possible explanation is that the penalties a creditor can exert on late payers is higher in rural areas, hence credit is repaid more promptly.

To summarize, we find evidence suggesting the cost and availability of finance to the supplier is an important consideration in determining whether credit is extended. This is consistent with any theory of trade credit. We do, however, find that higher gross margins are associated with higher accounts receivable, which is consistent with the price discrimination theory.

What was not predicted by any of the prior theoretical discussion is the greater extension of credit by firms with negative income and negative sales growth. Presumably such firms have higher costs of raising finance. If their extension of credit is voluntary, it suggests a different rationale for trade credit than any of the theories discussed so far. One explanation could be window dressing: managers of distressed firms make sales to low credit quality customers in order to keep the numbers up. Another could be that these firms try (but do not quite succeed) in signaling financial strength: strong firms offer credit and weakening firms attempt to imitate them.¹⁷ Finally, if the extension is involuntary, it suggests a cost of financial distress little investigated in the literature.

4. Who Receives Credit?

We now move on to analyze who receives credit from their suppliers and for how long. This will enable us to better examine the relevance of the financing advantage theory. A firm's stock of accounts payable will depend upon both the amount of credit its suppliers offer as well as the firm's demand for trade credit. We divide our analysis into two steps. We start by examining how much credit the firm's suppliers offer the firm. We conjecture that a firm's creditworthiness should affect how much credit it is offered. But we will also test if

¹⁷ A related conjecture (we thank David Brown for this) is that financially strong firms with deep pockets set trade credit standards in the industry so that the product-credit package puts financially weaker firms at a disadvantage. Such a conjecture begs the question of why the package cannot be unbundled by the other firms or customers, but suggests interesting avenues for future research.

factors that give the supplier a greater advantage in financing the firm influence how much credit it is offered.

4.1 Determinants of who is offered credit—purchases on account

4.1.1 Customer's credit quality. We know the fraction of purchases that each firm makes on credit. Since the opportunity to purchase on credit and borrow interest free for a few days dominates paying cash, we expect all firms to borrow during the initial period.¹⁸ Thus the firm's purchases on account should be an accurate measure of the credit offered to the firm. Since we do not know what fraction of a firm's cost of goods sold are purchases, we estimate the firm's credit purchases as the fraction of purchases made on credit multiplied by the firm's cost of goods sold. This variable is mismeasured because, in addition to purchases, the cost of goods sold includes other items. The most important of these is likely to be wages.¹⁹ As the survey does not report wages separately, we include employment scaled by assets in our regressions to correct for the inclusion of wages in our dependent variable. As can be seen in Table 5, employment is strongly positively correlated with the dependent variable. Having controlled for wages, the remaining variation in the dependent variable should capture the variation in credit purchases from suppliers, which is what we are trying to explain.

The firm's credit quality may be especially important in determining whether it is offered credit. The explicit price of trade credit does not appear to vary with the customer's credit quality—customers in an industry get standard trade credit terms [see Smith (1987)]. If suppliers do not use prices—they do not charge lower-quality borrowers a higher explicit price—then they must use quantity restrictions. We therefore expect higher-quality firms to be offered more credit. This is indeed the case. Firms of observably higher credit quality—as measured by variables such as size and profitability—receive significantly more credit from their suppliers (see Table 5, column 1). This effect survives the inclusion of two-digit SIC indicators (Table 5, column 2).

We have identified at least three aspects of the financing advantage theory: the supplier has better information than financial institutions,

¹⁸ Few industries offer discounts for immediate cash payment [see Dun and Bradstreet (1970)]. Most trade credit is advanced for a specific period of time. For example, payment may be due 10 days after the goods are delivered. Other trade credit is offered with a discount if the bill is paid prior to the due date. In either case, the implicit cost of the loan until the discount or due date is effectively zero.

¹⁹ In general, firms do not borrow from their employees. An interesting historical exception can be found in Rogers (1994).

Table 5
Trade credit supply: Purchases made on credit over assets

Independent variable	I	II ^b	III	IV	V
Proxy for wages					
Employees/assets (\$10,000)	.200* (.042)	.247* (.041)	.366* (.068)	.199* (.042)	.174* (.043)
Firm credit quality					
Log(book value of assets)	.049 (.033)	.042 (.032)	.105** (.048)	.051 (.033)	.060*** (.033)
Net profits/assets	.326* (.058)	.326* (.055)	.420* (.092)	.325* (.058)	
Log(1+firm age)	.044 (.196)	.073 (.186)	-.353 (.272)	.044 (.196)	.078 (.195)
Log(1+firm age) ²	-.029 (.043)	-.039 (.041)	.031 (.061)	-.030 (.043)	-.037 (.043)
Firm is incorporated	.476* (.108)	.510* (.103)	.221 (.153)	.481* (.108)	.452* (.108)
Relationships with financial institutions					
Longest relationship with lender (in years)	-.015 (.066)	-.017 (.063)	.121 (.098)	-.018 (.066)	.003 (.065)
Risk premium on most recent loan (premium over treasuries)			-.015 (.024)		
Firm denied request for loan in the last year (0,1)				-.213 (.203)	
Relationships with suppliers					
Net profits/assets (if profits > 0)					.422* (.064)
Net profits/assets (if profits < 0 and sales growth > 0)					-.844* (.275)
Net profits/assets (if profits < 0 and sales growth < 0)					.228 (.433)
Liquidation costs ^a					
Percent of inventory which is finished goods	-.725* (.167)		-.661* (.229)	-.717* (.167)	-.709* (.166)
Number of observations	1644	1706	758	1644	1644
R ²	12.0	21.2	15.4	12.0	13.0

The dependent variable is the firm's purchases on account divided by assets. Purchases on account is calculated as the percent of purchases made on account times the firm's costs of goods sold. The coefficients are estimated using ordinary least squares. Standard errors are in parentheses. Each regression includes one-digit SIC industry dummy variables (unless otherwise specified) and a constant whose coefficients are not reported. Firms in the financial industry (SIC 6000–6999) and service industry (SIC 7000–8999) are excluded unless otherwise stated. Due to low asset values 23 firms had extremely high ratios for purchase on account to assets. These observations were recoded to the 99th percentile of the distribution. We tested this approach by estimating the regression using a tobit with an upper limit of the 99th percentile of the purchase on account regression. The empirical results are qualitatively similar. Low asset values also caused some of the independent variables to be skewed. When the distribution of a variable was highly skewed, we recoded the upper percent of values to the 99th percentile of the distribution. These variables include operating profits to assets, employees to assets, and number of trade creditors to assets.

^a Industry variables are calculated using 1987 Compustat data. Each variable was calculated for firms in a two-digit SIC code industry. These average industry values were then matched to the firms in the NSSBF.

^b This regression includes 40 industry dummies, one for each two-digit SIC code in our dataset. The percent of inventory which is finished goods is based on industry averages and must therefore be dropped from this specification.

*, **, ***Coefficient significantly different from zero at the 1%, 5%, and 10% levels, respectively.

the supplier has better control, and the supplier has a better ability to liquidate goods. We can test for each of these aspects.

4.1.2 Relationships with financial institutions. From earlier work [Petersen and Rajan (1994)], we know that relationships with financial institutions appear to increase the availability of finance from financial institutions to the firm. We use the length of the longest relationship with a financial institution to measure how much information, possibly private, the lender has accumulated about the firm. It is also a measure of the firm's reputation in debt markets [Diamond (1989)]. If suppliers rely on signals sent by prior relationships with lenders in their decision to offer credit, trade credit offered should increase with the strength of relationships with financial institutions. If, on the other hand, suppliers generate their own information, proxies for relationships with financial institutions should not matter.

A relationship with a financial institution does not increase the trade credit offered to a firm. The effect of relationship length on the supply of trade credit is economically tiny and statistically insignificant ($\beta = -.015$, $t = -0.2$). We also include the number of banks from which the firm borrows. A firm that concentrates its borrowing with a single lender will develop a stronger relationship with that lender. The coefficient on the number of banks from which the firm borrows is also small and statistically insignificant (regression estimates not reported). Even whether a firm borrows from a bank at all, a fact easily observable to the firm's trade creditors, has no effect on the supply of trade credit.

The interest rate a financial institution charges its customers should include all credit quality relevant information that the lender can observe and thinks is relevant. Suppliers may look to it as a superior source of information. As a proxy for this information source, as well as an additional measure of credit quality, we include the risk premium (the firm's interest rate relative to a treasury bond of comparable maturity) a firm paid on its most recent loan. Firms that pay higher risk premiums on their most recent loan do receive less credit from suppliers. However, the effect is small and not statistically significant (see Table 5, column 3). Finally, we include an indicator for firms that have asked for but have been denied credit by financial institutions in the last year. Firms that have been denied their request for a loan in the previous year are offered less on account. The coefficient is not statistically significant.²⁰ These results appear to rule out the possibility that suppliers rely on banks to monitor on their behalf.

²⁰ Firms that report they were denied a loan request in the last year may not be the best or the worst firms. The best firms are not denied, because they are good credit risks. The lowest-quality firms may not bother to apply for a loan they do not expect to receive. It is only firms of intermediate quality that apply for and are turned down for a loan. If this is correct, the proxy is noisy, which would explain why being turned down for a loan has a statistically insignificant effect on the amount of trade credit a firm is offered.

4.1.3 Relationships with suppliers. We explore the value to suppliers of investing in future relationships with their customers by examining the coefficient on profits in Table 5 more closely. Recall that suppliers offer more credit to profitable firms. When we estimate separate coefficients for firms making profits and firms making losses, we find the coefficient on negative net profits is negative ($\beta = -.551$, $t = -2.3$, regression not reported). So suppliers seem to offer credit to the most profitable *and* the most unprofitable firms. This suggests that they might have some advantage in lending to lower-quality credit risks who might otherwise be shut out from institutional financing.

Both the financing advantage theory and the price discrimination theory suggest that trade credit should fall off for the lowest-quality credits. Why do suppliers seem eager to lend to the most unprofitable firms, when financial institutions are not? As argued earlier, one reason may be that a firm that is currently unprofitable may not remain so in the future. By investing in relationships with currently unprofitable but growing firms, a supplier may capture future profitable business from the firm.²¹ To test this idea, we divide the net profit variable into three categories: firms with positive profits, firms with negative profits but positive sales growth, and firms with negative profits and negative sales growth. The results are reported in column 5. The last group are distressed firms, for whom low profits lowers the credit offered by suppliers.²² By contrast, growing firms who are currently losing money get more credit the lower their profits ($\beta = -.844$, $t = 3.1$). A possible explanation of this is that, first, suppliers have an increasing advantage in lending to poorer-quality credits, and second, they do so only if they anticipate that growth in future business will compensate them for the risks they are taking.²³ By lending to these apparently high-risk firms, suppliers can invest in the future viability and profitability of their customers.

²¹ Banks in concentrated capital markets act in a similar way. They extend more credit to young firms than do banks in more competitive capital markets. The banks in concentrated capital markets anticipate correctly that they will be able to recoup their investment by charging higher rates when the firms expand and mature [Petersen and Rajan (1995)]. If suppliers have more market power over their customers than banks, they may be able to finance firms that banks cannot profitably finance.

²² The coefficient on net profits for firms with negative profits and negative sales growth is positive, but not statistically different from zero. Neither is it statistically different from the coefficient on net profits for firms with positive profits. Pooling distressed firms with profitable firms has no effect on the explanatory power of the regression.

²³ An alternative explanation is that firms with positive sales growth are more likely in the long run to repay than firms with negative sales growth. While this may indeed be true for long-term loans, trade credit is so short term that the growth in sales should have little impact. The probabilities of default may be lower in the group with positive sales growth (though one could argue firms in this group are more likely to be cash constrained). This could explain the higher credit extended to the group with positive sales growth, but not why the credit extended increases as firms become more unprofitable.

Finally, we include an indicator if the firm is located in an MSA (coefficient not reported). These firms are offered more credit, though the coefficient is not statistically significant.

4.1.4 Liquidation costs. The final source of financing advantage is the greater ability of suppliers (relative to financial institutions) to liquidate the firm's assets. Suppliers can repossess and resell goods to other buyers. But once the customer has transformed its inputs into outputs, they will be more costly for the supplier to sell and thus its competitive advantage over financial institutions in liquidating these goods is lost. As a proxy for the supplier's advantage in liquidating the borrower's assets we use the fraction of the firm's inventory that are finished goods. Since the NSSBF does not provide us with information on the composition of each firm's inventory, we use the average finished goods:total inventory ratio for Compustat firms with the same two-digit SIC code in 1987. The composition of inventory in an industry has a large effect on the credit that suppliers offer firms in our sample. A firm with only finished goods inventory, compared to zero finished goods inventory, will lower its purchases on account by 73 percentage points ($t = -4.3$).

To summarize our findings, suppliers do worry about the ability of the borrower to repay. In general, a firm with lower credit quality gets less credit. However, suppliers appear to support growing, cash-constrained firms with credit. Not only do the prospects of future profits give them a greater incentive to finance their customers, they may also have a financing advantage over financial institutions. Suppliers seem to use different criteria from financial institutions in assessing whether to offer credit. The availability of trade credit is not significantly related to the existence (or absence) of lending relationships with financial institutions. Finally, the ability of suppliers to liquidate collateral seems important. The lower the ratio of finished goods to inventory, the greater the amount of credit offered. Thus the financing advantage for suppliers appear to come from their low cost of information acquisition and their ability to more efficiently liquidate assets.

4.2 Determinants of who demands trade credit—accounts payable

4.2.1 Supply of trade credit. Having examined the supply of trade credit, we now turn to the determinants of a firm's demand for trade credit. Once a firm has purchased a good on credit, how long it waits (or can wait) before repaying will determine the level of the firm's accounts payable. An analysis of accounts payable can shed addi-

tional light on the financing advantage theory, though it will have no implications for the price discrimination theory.

We explain the firm's stock of accounts payable (normalized by assets) using the predicted supply of trade credit and proxies for the firm's demand for trade credit. We use the estimates from the previous section (Table 5, column 1) to calculate a predicted value of the purchases on account:assets ratio. Recall that this ratio is mismeasured to the extent that costs of goods sold include wages. We, therefore, subtract from the predicted ratio the firm's employee:assets ratio times the coefficient estimate of 0.200 for the employees:assets ratio estimated in Table 5, column 1.²⁴

The firm's stock of accounts payable increases in our estimate of the purchases that are supplied on account to the firm (see Table 3, column 1). The coefficient estimate of 0.027 is economically large and statistically significant. This coefficient implies that an increase in the purchases:assets ratio from zero to the median of 1.38 increases the firm's stock of accounts payable by about 4% of assets.

4.2.2 Demand for funding. Conditional on the supply of credit, the amount by which firms stretch their accounts payable should be determined by their demand for credit in general and their demand for trade credit in particular. The variables that proxy for the firm's credit demand include measures of the firm's investment opportunities, asset maturity, liquidity, as well as access to credit from financial institutions.

Firms that are growing more quickly presumably have more investment opportunities. A proxy for this is the change in sales scaled by assets. The underlying relationship between the demand for trade credit and sales growth is nonlinear. Increases in sales raise the firm's demand for credit. Each additional dollar of sales increases the demand for trade credit by 1.2 cents.²⁵ To put this number in perspective, a firm's cost of goods sold averages 43% of sales in our sample. So firms finance about 3% of this with trade credit. However,

²⁴ Instead of including an estimate of the supply of trade credit in this regression, we could have included the purchases on account variable from Table 5 and then used instrumental variables to estimate the coefficients. This is done in column 2 of Table 6. In addition to the other variables in the regression (column 1), we used employees per thousand dollars of assets, whether the firm was incorporated, and the percent of inventory which is finished goods as instruments. These are the variables we used in Table 5 to estimate trade credit supply. The coefficient estimates in column 1 and 2 are similar.

²⁵ For twelve percent of our sample, 1986 sales are not reported. We code the change in sales equal to zero for these firms and include a dummy variable for whether 1986 sales are missing. If these observations are essentially new high growth firms, then we would expect their demand for trade credit to be higher than the trade credit demand from a firm with zero sales growth. We do not find this. Firms with missing sales have slightly lower demand for trade credit than a firm which reports no change in sales. The coefficient on this variable is not statistically significant. Thus coding the firms with missing sales as having zero sales growth is correct on average.

trade credit is short-term credit. If we recalculate this percent based on monthly sales (rather than annual sales) increasing by one dollar, then firms finance about 33% of their increased purchases with trade credit. The coefficient on sales declines is negative, but small in magnitude ($\beta = -0.004$). Firms whose sales fall have higher accounts payable, but only slightly more. Combined with the evidence from Table 5, this suggests that suppliers are willing to finance high sales growth firms by offering more credit.

In samples of large firms, investment opportunities are typically thought to decline in firm size and firm age. For small firms, it is less clear that this is the case, for certain projects may become viable only after the firm has acquired adequate assets and experience. Our estimates (Table 3, column 1) indicate that firm size and firm age are only weakly positively correlated with the firm's accounts payable. The strong positive relationship apparent in Table 2 between firm size and accounts payable therefore comes mainly from the fact that larger firms are offered more trade credit—presumably because they are better credit risks—not because they have greater demand to borrow from their suppliers (see Table 5, column 1; Table 6, column 1).

We also include a crude proxy for whether firms need credit. Firms in the dataset report whether they have applied for a loan or line of credit from a financial institution in the past year. Fourteen percent of the firms in our sample have. We find that loan applications are uncorrelated with demand for trade credit. If there are nontrivial costs of applying, the decision to apply may depend upon the firm's expected success in getting a loan. So a number of firms may need credit but may not apply. This may explain why we do not find a significant correlation.

It is unlikely that a firm will finance long-term projects with trade credit. Most firms match the maturity of assets and liabilities, and Diamond (1991) and Hart and Moore (1991) present rationales for this. A measure of a firm's demand for short-term financing is its short-term assets.²⁶ Firms whose assets consist mainly of current assets (excluding cash) demand significantly more trade credit. At the margin, 17% of the firm's current assets are financed by trade credit (see Table 6, column 1). Interestingly, cash holdings have no empirical effect (coefficient not reported).²⁷

²⁶ The current assets ratio obviously varies dramatically across industries, ranging from a low of about 20% of assets in mining (SIC 1000–1499) and transportation and utilities (SIC 4100–4999) to a high of almost 60% in the wholesale trade industry (SIC 5000–5199).

²⁷ Firms with high cash holdings may have enough cash to not require accounts payable financing, or may have hoarded cash to repay accounts payable. It is not a priori clear which effect should predominate. The estimated coefficient on cash to assets is only 0.026 ($t = 1.1$).

Table 6
Trade credit demand: Accounts payable over assets

Independent variable	I	II ^b	III ^c	IV	V
Supply of trade credit					
Predicted supply of trade credit/assets ^a	.027** (.013)	.029** (.013)	.085* (.019)	.027** (.013)	.028** (.013)
Demand for capital					
Δ sales (86–87)/assets if positive, zero otherwise	.012* (.003)	–.001 (.008)	.012* (.003)	.012* (.003)	.012* (.003)
Δ sales (86–87)/assets if negative, zero otherwise	–.004 (.005)	.007 (.006)	–.002 (.005)	–.005 (.005)	–.004 (.005)
1986 sales missing (0,1)	.002 (.014)	–.001 (.017)	.002 (.014)	.002 (.014)	.005 (.014)
Log(book value of assets)	.005 (.003)	.004 (.003)	–.002 (.003)	.006** (.003)	.004 (.003)
Log(1+firm age)	.029*** (.016)	.036*** (.019)	.023 (.017)	.029*** (.016)	.029*** (.016)
Log(1+firm age) ²	–.006*** (.004)	–.006 (.004)	–.004 (.004)	–.006 (.004)	–.006 (.004)
Current assets excluding cash/assets	.166* (.013)	.156* (.018)	.168* (.015)	.169* (.013)	.161* (.013)
Firm applied for loan during previous year (0,1)	.002 (.010)	.005 (.011)	.003 (.010)	.003 (.010)	.001 (.010)
Credit availability					
Net profits/assets	–.019* (.006)	–.021* (.007)	–.039* (.007)	–.019* (.006)	–.019* (.006)
Available line of credit/assets				–.063* (.022)	
Firm denied credit request during previous year (0,1)	.012 (.017)	.019 (.019)	.010 (.017)	.012 (.017)	.012 (.017)
Log(1+longest relationship with lender) (in years)	–.011** (.005)	–.018* (.006)	–.009*** (.005)	–.011* (.005)	–.013* (.005)
Firm is located in an MSA	.017** (.007)	.012* (.008)	.013*** (.007)	.017*** (.007)	.019* (.007)
Price of trade credit					
Percent of credit purchases offered with early payment discounts					.006 (.011)
Early payment discounts missing					–.035* (.010)
Number of observations	1968	1588	1968	1968	1968
R ²	14.9	20.0	17.6	15.3	15.6

The dependent variable is the accounts payable:asset ratio reported by the firm. The coefficients are estimated using ordinary least squares. Standard errors are in parentheses. Each regression includes five industry dummy variables and a constant whose coefficients are not reported. Firms in the financial industry (SIC 60000–6999) and service industry (SIC 7000–8999) are excluded unless otherwise noted. Low asset values also caused some of the independent variables to be skewed. When the distribution of a variable was highly skewed, we recoded the upper percent of values to the 99th percentile of the distribution. These variables include purchase on account to assets, operating profits to assets, employees to assets, and number of trade creditors to assets. ^aPredicted trade credit supply is the estimated value of purchase on account over assets from Table 5, column 1. We adjusted our estimate of purchases on account by subtracting off 0.200 (the coefficient on employment over assets) times the value of employment over assets for each observation. This removed the mismeasurement in purchases on account caused by wages being included in cost of goods sold, but not purchases on account.

^bThis regression was estimated with instrumental variables. In addition to the other variables in the regression, we used employees per thousand dollars of assets, whether the firm was incorporated, and the percent of inventory which is finished goods as instruments. These are the variables that we used in Table 5 to estimate trade credit supply.

^cThis regression includes 36 industry dummies, one for each two-digit SIC code in our dataset.

*, **, ***Coefficient significantly different from zero at the 1%, 5%, and 10% levels, respectively.

In addition to age and size, we also include dummy variables for each of the two-digit industries represented in the data to proxy for differences in industry investment opportunities in Table 3, column 3. This increases the magnitude and statistical significance of several of the estimate.

4.2.3 Credit availability. Having corrected for the availability of trade credit, the firm's investment opportunities, and the maturity of the firm's assets, we now investigate if the firm's liquidity position and the availability of credit from financial institutions affects the demand for trade credit. If it does in a significant way, this would suggest that trade credit financing is lower in the "pecking order" than internally generated cash [Myers (1984)]. The firm's ability to generate cash internally decreases its demand for trade credit.²⁸ Each additional dollar of monthly profits lowers the firm's demand for trade credit by 23 cents ($= .019 * 12$) and the estimate is significant at the 1% level. The statistically significant and negative coefficient for cash flow in the demand equation (see Table 6) and the statistically significant and positive coefficient in the supply equation (see Table 5) adds credence to our argument that the firm's purchases on account measures the credit offered to the firm by its suppliers, and that we have therefore distinguished the "supply for trade credit" equation from the "demand for trade credit" equation.

The firm's demand for trade credit may also depend upon its access to credit from financial institutions. We first examine several explicit measures. Four percent of the firms in our sample report were turned down for a loan or were approved for an amount less than they requested. Since we have also included an indicator if the firm applied for a loan, we can distinguish firms that applied and were granted a loan from firms that apply and get less than they demanded. The latter demand more trade credit, although the coefficient is not precisely estimated. As discussed earlier, this may be a biased measure of rationing because credit-constrained firms that do not expect to receive a loan may choose not to apply at all, making the proxy noisy.

The second explicit measure of rationing we consider is the availability of unused lines of credit. Almost one-third of the firms in our

²⁸ Theoretically, cashflow rather than profits divided by assets is the correct variable. However, the NSSBF does not report depreciation as a separate expense in the profit and loss statement. We could estimate depreciation as a fixed fraction of the firm's assets and add estimated depreciation to operating profits to get cashflow. However, since we then divide profits (or cashflow) by assets, this would only change the coefficient estimate but not the explanatory power of the regression or the variable. Alternatively we could estimate depreciation as a constant percentage of the firm's property, plant, and equipment. Using a depreciation rate of 10 percent raises the coefficient on cashflow to assets marginally.

sample have lines of credit they have not completely drawn down. We find that firms with larger unused lines of credit demand less trade credit. The coefficient (-0.063) is large (see Table 6, column 4). While firms appear to finance their short-term assets with short-term liabilities, they appear to treat institutional finance and trade credit as substitutes. Note that by including only the unused portion of the line of credit, we avoid picking up the accounting identity.

Petersen and Rajan (1994) find that relationships between firms and financial institutions relax credit rationing. If trade credit borrowing comes lower down in the pecking order than borrowing from close financial institutions, we should find that the strength of relationships with institutions is negatively correlated with demand for trade credit. This is exactly what the data show. We use the log of one plus the length of the firm's longest relationship with a financial lender to measure the strength of the lending relationships. Longer relationships with institutions correlate negatively with a firm's demand for trade credit.²⁹ An increase in the length of the maximum relationship from 0 to 10 years (the minimum to the median), lowers a firm's accounts payables by over 3% of its assets. This result implies that trade credit is relied on mainly by firms that are constrained by their institutional lenders. If a firm can secure enough credit from its financial institution, it does not stretch out its accounts payable as long, suggesting that borrowing from trade creditors, at least for longer periods of time, is a more expensive form of credit. Finally, firms demand slightly more trade credit in MSAs where institutional financing is weaker. Coupled with our observation from Table 5 that firms in MSAs are offered somewhat more credit, this suggests that trade credit substitutes for institutional finance in more competitive markets.

4.2.4 Price of trade credit. Thus far we have argued that suppliers do not vary the price of trade credit much. But does the demand for trade credit depend on its price? We do not know the specific terms a firm faces, but we do know what fraction of its credit purchases are accompanied by early payment discounts. In our sample, three-quarters of the firms report receiving early payment discounts on at least some of their credit purchases. The early payment discount should encourage firms to pay early and thus reduce their accounts payable, holding the supply of credit constant. To test the price elasticity of demand we include the percent of credit purchases offered with early payment discounts. The coefficient is very small and sta-

²⁹ The length of the longest relationship is also correlated with the firm's age. The correlation coefficient is 0.55 in our sample. However, the length of the longest relationship is not a proxy for firm age which is included in the regression.

tistically insignificant (see Table 6, column 5). This is consistent with the argument that missing early payment discounts is expensive and the decision to take advantage of early payment discounts is driven not by the implicit cost of this credit but instead by whether the firm has an alternative source of credit. Only credit constrained firms take advantage of this expensive form of credit.

5. Discussion and Conclusion

We now attempt to draw together the evidence we have accumulated on the rationale for trade credit. In the absence of confirmatory evidence, some of these conclusions may better be termed conjectures, and await future research.

As might be expected, suppliers offer more credit to firms of higher credit quality. But these firms use less trade credit if they have access to institutional finance. Coupled with the observation that suppliers provide strong incentives for firms not to extend the term of the offered credit by giving substantial discounts for prompt payment and strict penalties for late payment [see Petersen and Rajan (1994)], this suggests that trade credit is more expensive than institutional finance, especially if used for medium-term financing.

The desire of suppliers to restrict firms to short-term financing suggests an advantage in that type of financing over financial institutions. What is the nature of that advantage? One possibility is that creditors obtain information about the firm routinely, and at low cost, from their transactions with the firm. Of course, financial institutions also produce private information about the firms to whom they lend [Slovin, Sushka, and Polonchek (1993)]. Suppliers do not, however, appear to rely on information provided by lending relationships; measures of the strength of institutional relationships or the risk premium on institutional loans granted have little effect on how much trade credit a firm is offered. A reasonable conclusion from the data is that suppliers collect and use different information than financial institutions. The most valuable aspect of this information may be how current it is. By monitoring repayment and using discounts as a trip wire, suppliers get a quick read on a firm's financial and economic health [see Smith (1987)].

Suppliers appear to use this informational advantage in lending to firms of currently suspect credit quality (current losses) but with high potential for future business (high sales growth), as well as firms neglected by financial institutions. Why might suppliers continue extending credit to these firms when financial institutions do not? In addition to getting faster information about any deterioration of the firm's prospects, suppliers may continue to have a significant hold

over the firm, so long as it continues production. This is unlike financial institutions whose control may be diminished by bankruptcy filings. Furthermore, suppliers can take added precautions such as making consignment sales when the customer's failure to avail of discounts or pay on time sets off a trip wire. Suppliers are in the best position to liquidate the goods they have sold the firm, provided it has not been transformed (and provided they are secured so suppliers can seize the goods). This may be why we find that the supply of trade credit increases in the extent to which inventories consist of raw materials.

In addition to having a greater ability to enforce repayment from risky firms, suppliers may also have greater incentive to offer credit than do financial institutions. When suppliers cannot discriminate by price, trade credit may be necessary to finance sales to those who cannot obtain credit from institutions. A supplier who cannot price discriminate has two margins with which to work: the price of credit and the price of the good. Thus the supplier's profit margin from a sale enables him to bear a lower profit or a greater loss on the credit than can a financial institution. We find that trade credit offered by a firm increases in the size of its margins on sales. Furthermore, if a firm and its supplier continue to transact in the future, the supplier has an implicit equity stake in the firm equal to the present value of the margins he makes on current and future sales of the product to the firm. This may far exceed the implicit equity stake a financial institution may have because of the potential for future business, and may explain why suspect growing firms tend to be financed by suppliers.

In summary, we find from our analysis of small firms that suppliers may have a financing advantage, especially when a firm is financially troubled. Also, we have indirect evidence from the correlation between margins and receivables that a firm may offer trade credit as a means of price discrimination. A more direct test of the price discrimination theory would be possible if we knew the set of firms to which a supplier sold. If the set of firms had uniformly high credit ratings, there would be no need to offer credit. If they had uniformly low credit ratings, the supplier could simply lower the price and let financial institutions finance. It is only if buyers come with all manner of credit rating that trade credit becomes a viable instrument of price discrimination. This test awaits more comprehensive data.

The single most important step for future research is to examine the determinants of trade credit over time. This will permit more powerful tests of the financing advantage and transaction costs hypotheses. More detailed data (for instance, on the relationships between suppliers and customers) will allow researchers to investigate the price discrimination and quality guarantee hypotheses more fully. The role

of financially healthy suppliers in intermediating finance to growing firms as well as the implications for the transmission of monetary policy deserves further investigation. Finally, we show that firms with sales declines are forced to extend relatively more trade credit without getting any more support from suppliers. This points to a potential cost of financial distress that has hitherto not been investigated. Furthermore, it suggests that trade credit may be a strategic tool for deep-pocket firms to increase the minimum scale of staying in the industry. The scope for research is obvious.

References

- Biais, B., Gollier, and Viala, 1993, "Why Do Firms Use Trade Credit?," mimeo, CEPR Conference, San Sebastian, Spain.
- Brennan, M., V. Maksimovic, and J. Zechner, 1988, "Vendor Financing," *Journal of Finance*, 43, 1127–1141.
- Calomiris, C., C. Himmelberg, and P. Wachtel, 1995, "Commercial Paper, Corporate Finance, and the Business Cycle: A Microeconomic Perspective," *Proceedings of the Carnegie-Rochester Conference Series on Public Policy*, 42, 203–250.
- Diamond, D., 1989, "Reputation Acquisition in Debt Markets," *Journal of Political Economy*, 97, 828–861.
- Diamond, D., 1991, "Debt Maturity Structure and Liquidity Risk," *Quarterly Journal of Economics*, 56, 709–738.
- Dun and Bradstreet, 1970, *Handbook of Credit Terms*, Dun and Bradstreet, New York.
- Emery, G. W., 1987, "An Optimal Financial Response to Variable Demand," *Journal of Financial and Quantitative Analysis*, 22, 209–225.
- Ferris, J. S., 1981, "A Transactions Theory of Trade Credit Use," *Quarterly Journal of Economics*, 94, 243–270.
- Hart, O., and J. Moore, 1991, "A Theory of Debt Based on the Inalienability of Human Capital," working paper, MIT.
- Long, M. S., I. B. Malitz, and S. A. Ravid, 1994, "Trade Credit, Quality Guarantees, and Product Marketability," *Financial Management*, 22, 117–127.
- Meltzer, A. H., 1960, "Mercantile Credit, Monetary Policy, and Size of Firms," *Review of Economics and Statistics*, 42, 429–437.
- Mian, S., and C. W. Smith, 1992, "Accounts Receivable Management Policy: Theory and Evidence," *Journal of Finance*, 47, 169–200.
- Myers, S. C., 1984, "The Capital Structure Puzzle," *Journal of Finance*, 39, 575–592.
- Petersen, M., and R. Rajan, 1994, "The Benefits of Lending Relationships: Evidence from Small Business Data," *Journal of Finance*, 49, 3–37.
- Petersen, M., and R. Rajan, 1995, "The Effect of Credit Market Competition on Lending Relationships," *Quarterly Journal of Economics*, 60, 407–444.
- Rajan, R., and L. Zingales, 1993, "What Do We Know about Capital Structure: Evidence from International Data?," CRSP working paper, University of Chicago.

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Rogers, F. H., 1994, "Man to Loan \$1500 and Serve as Clerk: Trading Jobs for Loans in Mid-Nineteenth-Century San Francisco," *Journal of Economic History*, 54, 34–63.

Schwartz, R. A., and D. Whitcomb, 1979, "The Trade Credit Decision," in J. Bicksler (ed.), *Handbook of Financial Economics*, North-Holland, Amsterdam.

Schwartz, R. A., 1974, "An Economic Model of Trade Credit," *Journal of Financial and Quantitative Analysis*, 9, 643–657.

Slovin, M. B., M. E. Sushka, and J. A. Polonchek, 1993, "The Value of Bank Durability: Borrowers as Bank Stakeholders," *Journal of Finance*, 48, 247–266.

Smith, J., 1987, "Trade Credit and Information Asymmetry," *Journal of Finance*, 4, 863–869.

Smith, K., 1980, *Readings on the Management of Working Capital*, West Publishing, St. Paul, Minnesota.