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Trade Credit and Credit Rationing in Canadian Firms

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Abstract

Burkart and Ellingsen (2004) develop a model of trade credit and bank credit rationing which predicts that trade credit will be used by medium-wealth and low-wealth firms to help ease bank credit rationing. This paper tests this and other predictions of the Burkart and Ellingsen model using a large sample of more than 28,000 Canadian firms. The author uses an endogenous method to divide the firms into the appropriate wealth categories rather than arbitrarily selecting firms likely to be credit-rationed. The data support the main predictions of the model quite well. The author finds that medium-wealth firms substitute trade credit for bank credit consistent with using it to alleviate bank credit rationing. The low-wealth firms use trade credit but it is positively linked to bank credit, suggesting those firms are constrained in both bank credit and trade credit markets, and so cannot use trade credit to adjust as much to negative shocks. The findings also suggest that there are very few unconstrained, high-wealth Canadian firms. The author also finds low-wealth, declining and distressed firms supply proportionally more trade credit than firms with healthier balance sheets.

Keywords: credit rationing

Executive summary

Trade credit refers to credit granted by a supplier to its customers. It is a relatively expensive form of financing, with implicit interest rates of over 40% if the firm does not take advantage of early-payment discounts. Yet trade credit is often identified as a very important source of short term finance for many firms. Thus, it is important to try to understand the role of trade credit in the economy. Theory suggests that one potential role for trade credit is as an imperfect substitute for bank credit for firms rationed in their access to bank credit.

In this paper, the author uses micro-data from the balance sheets of a large sample of Canadian firms to examine the relationship between trade credit and bank credit as a way to test for credit rationing.

Burkart and Ellingsen's (2004) model of trade credit and bank credit rationing predicts that trade credit will be used by medium-wealth and low-wealth firms to help ease bank credit rationing. It provides the theoretical framework for the analysis.

A firm's trade credit is estimated as a function of bank credit, lagged capital expenditure, profits, interest coverage ratio, and unexpected sales shocks, as well as year dummies and firm-specific fixed effects. The main variable of interest is bank credit. The other variables are proxies for asset specificity, wealth, creditor vulnerability and demand shocks, respectively. The theory predicts that high-wealth firms will not use trade credit, medium-wealth firms use trade credit as a substitute for bank credit and therefore, the two types of credit are negatively correlated. Low-wealth firms are expected to be constrained in both trade credit and bank credit, and so their use of trade credit will be positively correlated with their use of bank credit. High-wealth firms are not expected to use trade credit for financial purposes at all, since they are not constrained in their access to bank credit.

This paper uses an endogenous threshold method to divide the firms into the appropriate wealth categories, and then tests the predictions of Burkart and Ellingsen's model for firms in different wealth categories. The data support the main predictions of the theoretical model quite well. Medium-wealth firms substitute trade credit for bank credit consistent with using it to alleviate bank credit rationing. The low-wealth firms use trade credit, but it is positively linked to their bank credit, which suggests that those firms are constrained in both bank credit and trade credit markets, and so cannot use trade credit to adjust as much to negative shocks.

The findings also suggest that there are very few unconstrained, high-wealth Canadian firms. The author also finds that low-wealth, declining, and distressed firms supply proportionally more trade credit than firms that have healthier balance sheets.

In summary, the findings here suggest that trade credit seems to most benefit medium-wealth Canadian firms that seem to use it to supplement their bank credit and thus help to alleviate bank credit constraints.

1. Introduction

Trade credit refers to credit granted by a supplier to its customers. It is a relatively expensive form of financing with implicit interest rates over 40% if the firm does not take advantage of early payment discounts. Yet trade credit is often identified as a very important source of short-term finance for many firms. This raises several questions. Why do firms use trade credit instead of cheaper sources of finance? Why do suppliers provide credit when banks and other financial institutions exist to do so? Burkart and Ellingsen (2004) develop a new theory of trade credit that answers these questions by focusing on how the illiquidity of inputs reduces moral hazard risks, enabling suppliers to provide trade credit when bank credit would not be extended. Their model explains why firms of different wealth categories face different degrees of credit rationing and have different trade credit usage patterns. Their model shows that aggregate investment is higher when trade credit is available because it allows medium- and low-wealth firms to invest more than their bank credit constraints would otherwise permit.

The authors test their model by examining the relationship between trade credit and bank credit for a large panel of more than 28,000 Canadian firms.[1] The authors use an endogenous method to split the sample into categories of firms likely to face different degrees of credit constraints. The findings show that a large portion of Canadian firms appear to be credit rationed to some extent. The other predictions of the model appear to be fairly consistent with the data in that medium-wealth firms can use trade credit as a substitute for bank credit, but low-wealth firms seem to be constrained in both bank credit and trade credit markets.

The most common trade credit terms are simple net terms whereby full payment is required within a certain period after delivery, often 30 days. A more complex form of trade credit involves two-part terms such that a discount is offered if payment is made within the discount period, or full payment is required at the end of the net period. Surveys by Ng, Smith and Smith (1999) and Dun and Bradstreet (1970) indicate that the most common two-part terms are 2/10 net 30. This means a 2% discount is available if the buyer pays within 10 days of delivery, or the full amount is required if they pay 11 to 30 days after delivery. Two-part trade credit terms imply a very high effective annualized interest rate if the purchaser foregoes the discount, equal to 44.6% for 2/10 net 30 terms.[2]

Trade credit volumes are usually measured by accounts receivable (*AR*) and accounts payable (*AP*). Accounts receivable measures the unpaid claims a firm has against its customers at a given time, and therefore indicates its supply of trade credit. Accounts payable is a measure of its usage of trade credit. Trade credit volumes are economically important; for example, in 1998, accounts receivable for non-financial firms in Canada totalled $202.6 billion, and accounts payables were

1. The author refers to agents as "firms" but the data actually consist of enterprises, defined by Statistics Canada as families of businesses under common ownership and control for which consolidated financial statements are produced. Most businesses in Canada are single company enterprises. See *Financial and Taxation Statistics for Enterprises* 1998. Statistics Canada Catalogue no. 61-219-XPB, page 41.
2. Assuming a 10 day discount period and 2% discount rate for a $100 purchase, the full price can be viewed as the future value of a loan on the discounted amount for the remaining 20 day period. The implicit annualized interest rate can be found from the expression $98(1+i)^{365/20}=100$, which gives i=0.446.

$228.6 billion. Therefore, accounts receivable were equivalent to 13.4% of total sales revenue of $1,511 billion in 1998, and the total accounts payable made up 15.1% of sales.[3]

The next section provides a review of the theoretical and empirical literature on trade credit. The third section describes Burkart and Ellingsen's model of trade credit in the presence of bank credit rationing and the resulting testable hypotheses. Section 4 describes the data and summary statistics and section 5 explains the estimation methods. The regression results for the models of trade credit usage, supply and net trade credit are presented in section 6, and section 7 concludes.

2. Trade credit literature

Theories explaining why firms provide or use trade credit focus on several different motives. Broadly speaking, there are at least four important motives for supplying or demanding trade credit: financial motives, transactions costs, product market information asymmetries, and price discrimination. Petersen and Rajan (1997) provide a good review of the theories of trade credit. The primary focus in this paper is on financial explanations of trade credit.

2.1 Financial theories of trade credit

Financial factors are presented as a motive for both trade credit supply and demand. To explain why sellers supply trade credit, many theories assume a comparative advantage that suppliers have over financial institutions in supplying credit to certain segments of the market for short-term funds. One source of this advantage may be information asymmetries concerning the borrower's creditworthiness. When there are significant information asymmetries between lenders and borrowers, some potential borrowers may be credit-rationed by banks or other financial institutions.[4]

Petersen and Rajan (1997) explain that suppliers may have lower monitoring costs and are thus able to provide trade credit to firms that are bank-finance-constrained. Since suppliers observe the buyer at regular intervals, they may detect changes in the customer's financial health sooner than banks or other institutions. Furthermore, the supplier may be better able to enforce the credit contract with the threat of cutting off supplies. Another source of the supplier's comparative advantage may be their superior ability to salvage value from repossessed goods. The financing advantage suppliers may have allows them to provide liquidity to their customers.

The supplier's role in providing liquidity was also recognized in early models without asymmetric information by Emery (1984), Bitros (1979) and Schwartz (1974). Smith (1987) shows that the terms of trade credit offered by the supplier effectively screen buyers in the presence of information asymmetries about creditworthiness. Buyers who choose not to pay in

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3. Statistics Canada. *Financial and Taxation Statistics for Enterprises* 1998. Catalogue no. 61-219-XPB, page 74.
4. There is a relatively large literature on financing constraints and credit-rationing that arises due to information asymmetries in credit markets. See Hubbard (1998) for a review.

the discount period signal to the supplier that they are a greater credit risk and require additional monitoring.

Several recent papers formalize the relationship between bank credit rationing and trade credit due to information asymmetries. Jain (2001) provides a model of trade credit in which suppliers act as a second layer of financial intermediaries between banks and borrowers due to their lower monitoring costs. Biais and Gollier (1997) also emphasize the monitoring advantage of suppliers in a model where banks and suppliers have different signals about the borrower's credit-worthiness. Trade credit helps alleviate the adverse selection problem for banks by identifying firms with good investment opportunities. Burkart and Ellingsen (2004) argue that monitoring cost advantage does not fully explain the supplier's advantage over banks. They ask why would banks (specialists in evaluating creditworthiness) have less information than suppliers, and if they do, why do suppliers not use their superior information to lend cash rather than inputs? Burkart and Ellingsen develop a model in which trade credit suppliers can overcome the moral hazard problem of resource diversion by the borrower better than banks, because inputs are harder to divert than cash, and suppliers have a monitoring advantage with respect to input use only. Their model predicts that trade credit increases finance-constrained firms' access to bank credit; however, the poorest firms will be constrained in both bank credit and trade credit. The Burkart and Ellingsen model is the basis for the empirical work here and it is described in more detail in the next section.

Wilner (2000) examines trade credit relationships and the exploitation of market power. Large purchasers of inputs may use trade credit to exploit the trade creditors' dependence in cases of financial distress. In his model, large trade debtor firms can extract additional concessions from a dependent trade creditor in the case of financial distress, but they cannot do so with a trade creditor that has less financial stake in future sales to the trade debtor. He predicts that large customers with dependent trade credit suppliers will prefer trade credit to bank credit if they are financially distressed.

2.2 Empirical findings on financial motives for trade credit

Existing empirical work on financing models of trade credit supply is somewhat mixed. Nadiri (1969) finds empirical evidence that the amount of trade credit supplied is positively related to sales growth, and to improvements in the firm's own liquidity position. Mian and Smith (1992) show that bond-rated firms, which are assumed to have better access to low-cost financing, provide more trade credit than unrated firms do.

Petersen and Rajan (1997) use age and size as proxies for the suppliers' access to credit. They find evidence consistent with finance constraints in that older firms offer more trade credit than younger firms do, although the coefficients are not economically large. They do find a significant effect when size is used as a proxy for credit access; large firms offer significantly more trade credit than small firms do. However, small firms may not offer as much trade credit even if they also have ready access to funds from banks or other financial institutions due to economies of scale. Ng, Smith and Smith (1999) show that large firms may offer more trade credit because they experience scale economies in providing trade credit. After controlling for size, Ng, Smith and Smith do not find that liquidity is a significant determinant in suppliers' decisions to offer trade credit. Demirguc-Kunt and Maksimovic (2001) compare manufacturing firms in 40 countries and find that the use of trade credit is a complement to bank credit, suggesting that suppliers do act as financial intermediaries between banks and borrowers.

One of the most surprising findings of Petersen and Rajan (1997) is that net profits are negatively related to the amount of trade credit offered, and that even distressed firms with low sales growth and negative profits offer trade credit. They suggest that this may be a matter of window dressing, in that firms in trouble attempt to keep the sales numbers up by offering trade credit to low quality customers. It has also been suggested that predatory behavior may also explain the provision of trade credit by distressed firms. If stronger firms bundle goods and credit together, weak firms may also have to offer both to compete.

Petersen and Rajan (1995, 1997) provide some evidence of finance constraints and trade credit demand using data on firms' relationships with their banks. Using the duration of the firm's relationship with its primary financial institution as an indicator of the degree to which a firm is credit rationed, they find firms with shorter banking relationships rely more on trade credit.

Nilsen (2002) argues that firms with reduced access to other sources of credit use trade credit as a poor substitute for other sources of financing. He finds evidence supporting this view of trade credit demand and shows that trade credit is particularly likely to be used as a substitute for other credit during periods of tight monetary policy.

Although there is a sizable literature on trade credit, there has been very little analysis of trade credit data from Canada, especially for small firms. Since the banking system in Canada differs from that of the United States, there may be differences in the provision or use of trade credit. Petersen and Rajan (1997) also point out that panel data analysis is required to further our knowledge of trade credit usage and its implications. To the best of the author's knowledge, this paper is one of the first trade credit studies to use panel data with both public and private firms.

3. Theoretical framework

Burkart and Ellingsen (2004) model trade credit as a way of overcoming the potential moral hazard problem that exists when an entrepreneur's investment decisions cannot be perfectly observed by creditors. Their model generates equilibrium bank credit and trade credit limits which determine the model's testable predictions.

3.1 Model description

A risk-neutral entrepreneur with wealth $\omega \geq 0$ has an opportunity to undertake an investment project. The project converts an input into an output according to a production function $Q(I)$, where I is the input quantity actually invested into the project, and q is the total quantity of inputs purchased. The input price is normalized to 1 and output price is p. The entrepreneur is a price-taker in both the input and output markets. In a perfect credit market with interest rate r_{BC}, the entrepreneur would choose the first best level of investment $I^*(r_{BC})$ that solves the first order condition, $pQ'(I^*) = 1+r_{BC}$. The entrepreneur's wealth cannot fully fund this investment level,

$\omega < I^*(r_{BC})$, so he must borrow. There are two possible sources of external funding, bank credit and trade credit from the input supplier.

It is possible that the entrepreneur diverts some project resources for private gain rather than investment, creating a moral hazard problem for both types of creditors. Therefore, they ration the credit available to the entrepreneur. Banks and suppliers are assumed to operate in competitive markets, and they simulanteously offer a loan contract to the entrepreneur. The bank loan specifies the bank credit limit $\overline{BC}$ and interest rate r_{BC}. Similarly, the supplier's loan contract indicates the maximum amount of trade credit it will provide $\overline{TC}$, input purchases q, and trade credit interest rate r_{TC} (i.e., the implicit cost of not paying in the discount period). A key assumption of the model is that banks and suppliers differ in their exposure to moral hazard because suppliers have a monitoring advantage over the banks. Suppliers observe input purchases and revenues but not investment, whereas banks observe only revenues. The supplier conditions its lending on input purchases, $\overline{TC}(q)$ but the limit on bank credit is a fixed amount $\overline{BC}$.

If the entrepreneur diverts a unit of cash, he gets some amount $\varphi < 1$ of private benefit. Thus φ can be viewed as creditor vulnerability. Since inputs have to be converted to cash and then diverted, the private gain is from diverting a unit of input is $\beta\varphi \leq \varphi$ which depends on $\beta \leq 1$, the liquidity of the input. More liquid inputs have larger β and are more attractive for diversion.

Since banks are assumed to be competitive, they earn zero profits and equilibrium bank interest rates r_{BC} = 0. The trade credit interest rate (r_{TC}) is assumed to be higher than r_{BC}, so the entrepreneur uses trade credit only if the cash available from his own wealth and bank credit are less than the desired investment level, i.e., if $\omega + \overline{BC} < I^*(r_{TC})$. If the entrepreneur does not divert any resources, he buys inputs $q = \omega + \overline{BC} + TC$ and his trade credit utilization is TC^U, just enough to invest the desired amount or up to the trade credit limit,

$$(1) \qquad TC^U = \min\left\{I^*(r_{TC}) - \overline{BC} - \omega, \overline{TC}(q)\right\}$$

After accepting credit offers from a bank and a supplier, the entrepreneur chooses q, I, BC, and TC to maximize his utility,

$$(2) \qquad U = \max\left\{0, pQ(I) - BC - (1 + r_{TC})TC\right\} + \varphi\left[\beta(q - I) + (\omega + BC + TC - q)\right]$$

subject to the constraints,

$$\begin{aligned} q &\leq \omega + BC + TC \\ I &\leq q \\ BC &\leq \overline{BC} \\ TC &\leq \overline{TC}(q) \end{aligned}$$

The first term in the utility function is the entrepreneur's residual return from investing the available resources, and the second term is his private benefit from diverting inputs and cash respectively. In addition to four constraints shown in (2), Burkart and Ellingsen derive two incentive compatibility constraints shown in equations (3) and (4), to ensure that investment generates a residual return to the entrepreneur that is greater than or equal to his private payoff from diversion. Equation (3) ensures the entrepreneur does not exhaust all available trade credit and then divert all inputs and remaining cash. Equation (4) is required to prevent the entrepreneur from not purchasing any inputs at all and just diverting all the cash.

$$(3) \qquad pQ(\overline{BC} + TC^U + \omega) - \overline{BC} - (1 + r_{TC})TC^U \geq \varphi\beta(\overline{BC} + \overline{TC} + \omega)$$

$$(4) \qquad pQ(\overline{BC} + TC^U + \omega) - \overline{BC} - (1 + r_{TC})TC^U \geq \varphi(\overline{BC} + \omega)$$

Constraints (3) and (4) give the equilibrium credit limits $\overline{BC}$ and $\overline{TC}$. Based on their differing credit limits, entrepreneurs with different wealth levels have different credit usage and investment behaviour, as summarized in Table 1.

Table 1. Borrowing and investment behaviour by firms in various wealth categories in the Burkart and Ellingsen model

	High-wealth	Medium-wealth	Low-wealth
Bank credit usage	$BC < \overline{BC}$	$BC = \overline{BC}$	$BC = \overline{BC}$
Trade credit usage	$TC = 0$	$TC < \overline{TC}$	$TC = \overline{TC}$
Investment level	$I = I^*(r_{BC})$	$I = I^*(r_{TC})$	$I < I^*(r_{TC})$

The model predicts high-wealth entrepreneurs have sufficient internal wealth to finance their desired investment $I^*(r_{BC})$ and therefore they use less bank credit than their limit, $BC < \overline{BC}$ and do not use trade credit (*TC*) for financing.[5] Medium-wealth entrepreneurs must borrow to invest $I^*(r_{TC})$. They exhaust their bank credit limit $BC = \overline{BC}$, but not their trade credit limit, $TC < \overline{TC}$.

Since trade credit is more expensive, investors prefer bank credit, and medium-wealth entrepreneurs only use trade credit as an imperfect substitute once they reach their bank credit limit. Entrepreneurs with sufficiently low-wealth cannot obtain enough credit to invest $I^*(r_{TC})$ even when they exhaust both credit lines.

In aggregate, however, the availability of trade credit results in more total investment because entrepreneurs with medium or low-wealth are able to invest more than if bank credit were the only source of financing. Therefore, trade credit helps to ease bank credit rationing.

5. Other authors prove that firms may use trade credit for other reasons such as reducing transactions costs, as in Ferris (1981). See Petersen and Rajan (1997) for a review of the literature on motives for using trade credit.

3.2 Testable hypotheses

Burkart and Ellingsen derive the comparative static effects of changes in the model parameters on the equilibrium credit limits $\overline{BC}$ and $\overline{TC}$ given by equations (3) and (4). The authors prove the two credit limits move together for a given change in any of the parameters. An increase in wealth (ω) or product price (p) increase both $\overline{BC}$ and $\overline{TC}$ because they increase the entrepreneur's residual return from investment relative to diversion. Similarly, more illiquid inputs (lower β) or greater creditor security (lower φ) make diversion less profitable relative to investment and raise the credit limits. A higher trade credit interest rate (r_{TC}) decreases the two credit limits because it reduces the payoff to investment relative to diversion. These comparative static results generate empirically testable predictions. Table 2 summarizes the sign predictions and the regression variables used to test them. The regression model is explained in section 5.

Table 2. Sign predictions for trade credit usage in the Burkart and Ellingsen model

Model parameter	Regression proxy	Predicted change in trade credit use from an increase in explantory variable		
		Low-wealth	Medium-wealth	High-wealth
Bank credit *(BC)*	*LOANS/SALES*	positive	negative	0
Input illiquidity *(-β)*	*CAPEX/SALES*	positive	0	0
Wealth *(ω)*	*PROFIT/SALES*	positive	negative	0
Creditor security *(-φ)*	*COVRATIO*	positive	negative	0
Product price (*p*)	*SALESSHOCK*	positive	ambiguous	0
Trade credit cost (r_{TC})	*n.a.*	negative	ambiguous	0

Since the trade credit and bank credit limits are both binding for low-wealth entrepreneurs, the sign predictions for their trade credit usage behaviour are the same as the comparative statistics for $\overline{BC}$ and $\overline{TC}$ described above. The low-wealth entrepreneurs are also predicted to have a positive relationship between bank credit and trade credit because any change to one limit affects the availability of the other kind of credit. Thus, one of the main predictions of the model is that, for low-wealth firms, trade credit and bank credit are complements.

For the medium-wealth group, the predictions are more complex, as shown in the middle column of Table 2. These entrepreneurs are at their bank credit limit but they have not exhausted the trade credit available to them. Therefore, they compensate for reductions in bank credit by increasing their use of trade credit. This credit substitution effect for medium-wealth firms is a key prediction to test in this study. Burkart and Ellingsen also predict that medium-wealth entrepreneurs trade credit usage is decreasing in wealth and increasing in creditor vulnerability (since these variables both change $\overline{BC}$). The authors show that liquidity does not affect how much trade credit the medium-wealth entrepreneurs use. The sign predictions for product price or the trade credit interest rate are ambiguous because changes in those parameters have opposing effects on trade credit usage.

High-wealth entrepreneurs do not use trade credit for financing in Burkart and Ellingsen's model, so there are no significant relationships predicted between trade credit usage and the explanatory variables for the high-wealth group.

The Burkart and Ellingsen model focuses primarily on trade credit usage. With respect to a firm's decision to *offer* trade credit, the authors predict that bank-credit-constrained entrepreneurs will offer trade credit up to the point where an extra dollar of trade credit given earns as high a return as an extra dollar invested. Note that part of the marginal benefit of providing an extra dollar of trade credit is that the entrepreneur can then borrow against those illiquid trade credit claims (accounts receivable). Thus, even low-wealth entrepreneurs that will offer trade credit, and there is a positive relationship between the amount of trade credit they supply and the bank credit available to them.

4. Data and summary statistics

This study uses annual firm-level data from Statistics Canada's Financial and Taxation Statistics for Enterprises (FTSE) unpublished microdata files. The data cover an 11-year period from 1988 to 1998. The FTSE is a detailed database of balance sheet, income statement and corporate income tax data. A key advantage of the FTSE microdata is that it includes both public and private firms, including some very small firms which may be most likely to face credit constraints. By contrast, commercial databases often include only publicly-traded firms. Furthermore, the FTSE database is large. The author uses only a subset of the observations where sales growth is non-negative (since that is the criteria used to identify firms with good investment opportunities) but this still leaves 72,291 observations on 28,749 firms. Note that some firms have fewer than 11 years of data, so the panel is unbalanced. The Appendix provides more detail on the sample data and the construction of variables.

Over the sample period, aggregate FTSE data show that nominal total sales of goods and services by Canadian non-financial firms increased from $991 billion in 1988 to $1,510 billion in 1998.[6] By comparison, the sample firms' weighted sales total $496 billion in 1988 and $613.5 billion in 1998. Over the 11 year period studied, the sample firms' weighted sales account for 36.8% to 59.6% of the aggregate sales for the Canadian non-financial sector.

Table 3 presents summary statistics for the variables and observations used in the main regression analyses. Perhaps the most striking feature of the data is that the mean and median values are very different for most variables, often by a factor of ten or more. This reflects the fact that the population of Canadian firms consists of many small firms and a few large firms. The means are strongly influenced by the large firms and are usually much higher than the median values. For accounts payable, which measure trade credit utilization, the mean is $6.5 million but the median is only $327,000 in 1997 Canadian dollars. The mean accounts receivable are somewhat larger than accounts payable at $7.3 million, but the median value is only $362,000. Net trade balances are quite small but similarly skewed. Consistent with the reported importance of trade credit as a source of finance for small firms, accounts payable and accounts receivable are comparable in size to the bank loan amounts for this sample of firms. Capital expenditures and profits are considerably smaller, with mean values of $3.8 million and $2.2 million respectively. Sales average $65 million with a median value of $5 million.

6. Statistics Canada. *Financial and Taxation Statistics for Enterprises* Catalogue no. 61-219-XPB, various years.

Table 3. Summary statistics for Canadian firms 1988-1998 (in thousands of 1997 constant Canadian dollars)

	Mean	Median	Standard deviation
ACCTS. PAYABLE (AP)	6468.81	327.00	51105.44
ACCTS. RECEIVABLE(AR)	7277.39	362.00	55377.60
NET TC (AR-AP)	808.57	16.00	29734.52
LOANS	7733.90	204.84	86894.46
CAPITAL EXPENDITURE	3783.41	67.26	40518.97
PROFIT	2221.49	73.28	41457.92
SALES	64967.17	4999.00	460117.80
AP/SALES	0.094	0.073	0.092
AR/SALES	0.109	0.091	0.106
NET TC/SALES	0.016	0.009	0.112
LOANS/SALES	0.085	0.012	0.169
CAPITAL EXP./SALES	0.046	0.014	0.081
PROFIT/SALES	2.915	1.855	49.916
COVERAGE RATIO	25.07	2.76	336.52
SALES GROWTH (Y/Y%)	125.23	12.43	10647.94

Note: The subset of data selected represent 72,291 observations of 28,749 firms.

Scaling the variables by sales gives the proportion of trade credit used or supplied by the firm. The ratios are less skewed since the medians and means are fairly similar for most variables. The mean and median for *AP/SALES* are 0.094 and 0.073 respectively, and for *AR/SALES*, the mean and median values are 0.109 to 0.091. On balance, the net trade credit to sales (*NET TC/SALES*) is slightly positive for these firms with non-negative sales growth. The Canadian data here seem broadly consistent with findings from Petersen and Rajan (1997) who study U.S. trade credit data from 1987. The U.S. firms in their sample have mean *AP/SALES* of 0.044 for small firms and 0.116 for large firms; and they find mean *AR/SALES* of 0.073 for small firms, and 0.185 for large firms.

5. *Estimation method*

Credit rationing is believed to primarily affect firms with good investment projects by preventing them from fully borrowing against those opportunities. To operationalize this idea, the author assumes firms with good investment opportunities are those with non-negative sales growth from the previous year, so the analysis focuses on those observations.

5.1 Trade credit usage regressions

The main predictions of the Burkart and Ellingsen model pertain to trade credit usage, which is commonly measured by accounts payable (*AP*). The author tests the theoretical predictions summarized in Table 2 by estimating the fixed effects regression (see equation 5).[7]

$$\frac{AP_{it}}{SALES_{it}} = \alpha + \beta_1 \frac{LOANS_{it}}{SALES_{it}} + \beta_2 \frac{CAPEX_{it-1}}{SALES_{it-1}} + \beta_3 \frac{PROFIT_{it}}{SALES_{it}} + \beta_4 COV_{it} + \beta_5 SALESSHOCK_{it} + u_i + e_{it} \quad (5)$$

All the non-ratio variables are scaled by sales to control for possible heteroskedasticity due to differences in size. The key hypothesis tests concerning the substitution or complementarity of bank credit and trade credit involve the regressor *LOANS/SALES* which measures bank credit in the form of bank loans. Capital expenditure (*CAPEX/SALES*) is intended to reflect the firm's decision to use inputs for investment purposes rather than for diversion, and therefore reflects the illiquidity of inputs purchased by the firm. A high level of investment in capital goods should correspond to a smaller likelihood of diversion by the firm because firms investing heavily in capital equipment are assumed to have more firm-specific assets which are less liquid and harder to divert. Capital expenditure is lagged one period since accounts payable may be a component of current capital expenditures if the firm purchases capital items with trade credit.

Wealth is operationalized by net income before tax, referred to here as *PROFIT*.[8] The interest coverage ratio (*COV*) is a standard measure of credit quality and is included in the regression as a proxy for creditor security. A higher coverage ratio improves the likelihood of repayment and reduces creditor vulnerability.

The *SALESSHOCK* variable controls for unexpected changes in demand conditions faced by the firm, corresponding to changes in output prices (p) in the theoretical model. The *SALESSHOCK* variable consists of the residuals from an auxiliary OLS regression of sales on a full set of industry and year dummy variables. The predictions from the auxiliary regression produces the expected sales for a firm in a given year and industry, and the residuals capture demand shocks faced by individual firms. The author does not have a measure of trade credit financing cost in the regression; however, Ng, Smith and Smith (1999) and others have observed that there is very little variation in trade credit terms over time, but considerable cross-industry variation. The author includes time and industry dummy variables in the regressions to control for these effects.

The predicted effects of the explanatory variables differ across firm groups, as shown by the signs in Table 2. For the low-wealth firms, the author expects that all the variables will have positive coefficients because an increase in any of them raises both credit limits, and since these

7. Fixed effects was chosen over random effects based on the results of a Hausman test comparing the fixed and random effects coefficients. The chi-square test statistic comparing regressions on the overall sample was 424.02 with p-value 0.000, which means we reject the hypothesis of no significant difference in the random and fixed effect estimators. Since the fixed effects estimator permits covariance between firm-specific effects and the other regressors, which is likely the case with the data, the author uses fixed effects.
8. Net income is broader than profits but the author uses the terms interchangeably here. Detailed variable definitions and data descriptions are given in the Appendix.

firms are at their limits, their trade credit usage should increase. For the medium-wealth firms, the explanatory variables will usually have negative coefficients because they increase both credit limits causing these firms to substitute away from trade credit. There are some opposing effects for the medium-wealth firms so *CAPEX/SALES* has a zero coefficient, and *SALESSHOCK* is ambiguous. All coefficients are predicted to be zero for the high-wealth firms because trade credit usage is unrelated to financing decisions in the Burkart and Ellingsen model.[9]

An important econometric issue here is that some of the regressors in equation (5) are likely to be endogenous. In particular, bank credit and trade credit may be simultaneously determined, so bank credit will not be exogenous. Similarly, it is not clear that *PROFIT* or *COV* are not determined within the model in that firms with better access to trade credit may have higher profits or higher coverage ratios. Unfortunately, finding appropriate instruments from the available dataset of financial variables is difficult because most of the alternatives are not exogenous. The endogeneity problem potentially confounds interpretation of the results, and the results should not be interpreted as describing a causal relationship. Nevertheless, the author thinks the findings are informative as to the relevant relationships and patterns of trade credit behaviour across firm types.[10]

5.2 Trade credit supplied and net trade credit regressions

To analyze trade credit supply behaviour, the dependent variable in the regression is *AR/SALES*. The theoretical model predicts that a bank-credit-constrained firm will offer trade credit as long as the trade credit extended earns as high a return as their investment project. The author expects that firms with slow sales growth probably have fewer good investment opportunities than faster-growing firms, so an explanatory variable, *GROWTH*, is added to the regression equation for trade credit supplied. The *GROWTH* variable is expected to have a negative coefficient. Since *AR* claims can be used as collateral to obtain additional bank loans, a positive relationship between trade credit supplied and *LOANS/SALES* is expected, although it is not clear which way the causality will run. The other variables should have the same signs as predicted above because the firm still faces a diversion decision—whether to divert bank credit or use it to finance accounts receivable (trade credit lending).

Although the model does not explicitly deal with net trade credit (*AR-AP*), several other studies examine the relationship between trade credit supplied and trade credit used. One can interpret the main theoretical results from Burkart and Ellingsen concerning the substitution or complementarity between bank and trade credit as affecting net trade credit positions by considering the effects of a reduction in the bank credit limit. Medium-wealth firms can increase their use of trade credit to make up for the decrease in bank credit. They may also choose to decrease the credit they supply, *AR*, or perhaps to preserve good relationships with their

9. Other models show firms may use trade credit for non-financial reasons such as reducing transactions costs as in Ferris (1981).
10. Standard approaches to the endogeneity problem such as using lags as instruments and GMM estimation methods could be employed, but would result in the loss of a large number of observations on the small firms because these firms usually have only one or two years of data. Future work will attempt to address the endogeneity issue by using simultaneous equations.

customers they keep *AR* the same. Whether *AR* remains fixed or is decreased, net trade credit (*AR-AP*) will decrease as long as *AP* increases by more than *AR* decreases. So for medium-wealth firms, to see a positive coefficient on the bank loans variable in the net trade credit regression is expected.

For low-wealth firms, bank credit reductions decrease trade credit usage *AP* and may also lead them to reduce *AR*. A reduction in bank credit increases net trade credit (*AR-AP*) for low-wealth firms if *AR* remains constant or is reduced by less than *AP*. If *AR* and *AP* are reduced by the same amount in response to lower bank credit, then net trade credit is unchanged. Therefore, the author expects that low-wealth firms' net trade credit is more negatively related or unrelated to the bank credit variable.

5.3 Sample splitting and estimating wealth category thresholds

As the theory predicts different behaviour for different wealth categories, the basic model in equation (5) is estimated for each wealth group by adding dummy variables for low- and medium-wealth categories and interacting these dummy variables with the other explanatory variables.

To define the high-, medium- and low-wealth categories, one needs to find a lower and upper threshold that distinguishes low-wealth from medium-wealth and medium-wealth from high-wealth. Previous studies on credit rationing often use arbitrarily assigned thresholds, such as the median or other quartiles. Since the sample here has so many small firms and appears to be quite skewed with respect to profits and other variables, there is likely to be a large proportion of credit-constrained, low-wealth firms. Nevertheless, it is not obvious where the boundaries between wealth groups are. Therefore, it seems appropriate to try to find the wealth thresholds using an endogenous method.

The author follows the approach recommended by Hansen (2000) to find endogenous thresholds. First, to find the low-wealth threshold, the author defines a *LOW* dummy variable which equals one if *PROFIT* is below a given value, which is allowed to range from minus \$50,000 to \$174,000 1997 dollars. This range corresponds to about the 10th and 75th percentiles of the profit variable, giving a large window around the median, a natural starting point. The *LOW* dummy and interactions of *LOW* with the other five main regressors are added to the basic regression model which is then estimated separately for each value of *PROFIT* in the range. The sum of squared residuals from each regression are then compared and the low-wealth threshold selected is the value of *PROFIT* that minimizes the sum of the squared residuals. This process yielded a lower profit threshold of \$60,000, equal to about the 55th percentile of *PROFIT*. Low-wealth firms are therefore defined as those with profit less than \$60,000 in 1997 dollars.

Given the lower threshold, the same process is used to find a second, upper threshold by defining a *MEDIUM* dummy variable and interacting it with the other five regressors shown in equation (5). The *MEDIUM* dummy equals one when *PROFIT* is greater than or equal to \$60,000 and less than the upper threshold value which is allowed to range from \$60,000 to \$3.132 million, the 95th

percentile.[11] This second search process did not yield a distinct upper threshold, since the second value of profit that minimized the sum of squared residuals was $61,000, which is not statistically different from the other threshold. Therefore, this sample appears to have only one threshold, which implies that there are no high-wealth, unconstrained firms, but there are distinct categories of low-wealth and medium-wealth firms. The author tests the robustness of this finding by imposing several different single and double thresholds for the wealth categories.

6. Regression results

6.1 Trade credit usage regression results (AP/SALES)

The main regression estimates for accounts payable to sales are presented in Table 4. Model 1 reports the results of estimating equation (5) including the *LOW* wealth dummy variable and the interactions of *LOW* with the other five regressors. *LOW* equals one if *PROFIT* is less than the estimated low-wealth threshold of $60,000. Since the search process did not find a second threshold, the author interprets the data as having only low-wealth and medium-wealth firms, and the medium-wealth firms are the reference group in model 1.

Overall, the estimates from model 1 conform quite well to the main predictions of the Burkart and Ellingsen model. The medium-wealth firms do seem to substitute trade credit for bank credit since the coefficient on *LOANS/SALES* is negative and significantly different from zero at the 1% level. The low-wealth firms have a positive and significant coefficient on *LOANS/SALES*, implying that for them bank credit and trade credit are complements rather than substitutes, consistent with the theory. All the other variables in model 1 have the predicted signs for the medium-wealth firms, except *PROFIT/SALES* for which the sign is contrary to the predictions for both low- and medium-wealth firms. The contrary signs on the *PROFIT/SALES* variable suggests that the theory's cyclical implications do not match the data well, however, neither coefficient is significantly different from zero at the 5% level. The predictions for variables other than bank loans hold up less well for the low-wealth firms. Three variables, *LOWxPROFIT/SALES*, *LOWxCOV* and *LOWxSALESSHOCK*, have signs contrary to predictions, but they are also very small and not significant at the 5% level.

Although the estimated relationships between bank credit and trade credit are statistically significant, they do not appear to be economically significant. For the average medium-wealth firm in the sample, a one standard deviation increase in its bank credit to sales ratio (from 0.085 to 0.245) results in a decrease in its *AP/SALES* ratio of just 0.003, reducing the average trade credit usage ratio from 0.094 to 0.091. For low-wealth firms the estimated bank loans coefficient of 0.0246 (-0.0181 + 0.0327) implies that a one standard deviation increase in *LOANS/SALES* of 0.169 would result in an increase in *AP/SALES* of just 0.004, raising the ratio to 0.098 for the average firm.

11. PROFIT increases by increments of $1,000 in the lower threshold search, and increments of $5,000 in the upper threshold search.

Table 4. Trade credit usage regression results fixed effects regression

Dependent variable is *AP/SALES*	(1) Low-wealth threshold		(2) No wealth thresholds		(3) Low- and high-wealth thresholds	
	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
LOANS/SALES	-0.0181***	-2.51	9.66e05	0.02	-0.0144	-1.51
$CAPEX_{t-1}/SALES_{t-1}$	5.26e05	0.67	2.18e04	0.92	0.0029	0.54
PROFIT/SALES	0.0013	1.51	-2.11e05	-0.65	1.09e04	1.01
COV	-2.62e06**	-2.23	-3.49e06**	-2.32	-2.54e06**	-2.20
SALES SHOCK	-1.31e08***	-4.28	-1.32e08***	-4.22	-1.30e08***	-4.33
LOW WEALTH DUMMY	0.0017	1.55			0.0086***	4.30
LOWxLOANS/SALES	0.0327***	4.45			0.0278***	2.81
$LOWxCAPEX_{t-1}/SALES_{t-1}$	5.96e05	0.57			-0.0022	-0.41
LOWxPROFIT/SALES	-1.93e05*	-1.94			-0.0016	-1.42
LOWxCOV	-3.06e05	-1.56			-3.09e05	-1.56
LOWxSALES SHOCK	-1.61e09	-0.85			-3.38e09*	-1.79
MED.WEALTH DUMMY					0.0076***	3.88
MEDxLOANS/SALES					-0.0071	-0.63
$MEDxCAPEX_{t-1}/SALES_{t-1}$					-0.0029	-0.54
MEDxPROFIT/SALES					0.0016	1.06
MEDxCOV					1.30e05	0.81
MEDxSALES SHOCK					1.24e09	0.10
Adjusted R-squared	0.6550		0.6566		0.6584	

Notes: Statistical significance is indicated by *** for 1%, ** for 5% and * for 10% levels, respectively. All regressions use White's robust standard errors and include a constant and year dummy variables. The low-wealth threshold to identify low-wealth firms was found by estimating model (2) allowing *PROFIT* to range from (-50 to 174) and selecting the profit value that minimized the sum of squared residuals. This method defined low-wealth firms as those with *PROFIT*<\$60,000 (about the 55th percentile). The same method found no second upper threshold to define high-wealth firms. Models (2) and (3) provide robustness tests of the thresholds. Model (3) imposes the 90th percentile of *PROFIT*, \$972,000 to define medium-wealth firms as those with 60≤*PROFIT*<972. See text for more detail on method and robustness tests. The subset of data selected represent 72,291 observations of 28,749 firms.

Model 1 relies on an estimated threshold to split the sample into low- and medium-wealth firms. To test the robustness of this threshold, the author also estimates the model using the 25th, 35th, 45th 50th, 65th, 75th, 85th and 95th percentiles of *PROFIT* as threshold to define the *LOW* dummy variable. The results are qualitatively the same as reported for model 1 in Table 4. The coefficient on *LOWxLOANS/SALES* is always positive and significant at the 1% or 5% level for all the thresholds tested. For medium-wealth firms, the coefficient on the bank loans variable is always negative, and is significantly different from zero at the 5% level when the low-wealth threshold is anywhere from the 45th to 85th percentiles of *PROFIT*, equal to a range of \$25,000 to \$443,000 in 1997 Canadian dollars.

Model 2 in Table 4 presents regression results of estimating the model without any wealth thresholds. This yields coefficient estimates that do not correspond very well to the Burkart and Ellingsen's theoretical predictions for any of the three wealth categories. *LOANS/SALES* has a very small coefficient that is not statistically significant. This may reflect opposing signs for different wealth groups that effectively cancel each other out when all the observations are pooled together.

Even though the endogenous search method did not find a second threshold, the theory predicts there are two thresholds (three wealth categories). Therefore, in model 3 the author also estimates a version that arbitrarily imposes a second, upper threshold for wealth equal to the 90th percentile of *PROFIT* or \$972,000. Model 3 has an additional dummy variable to indicate medium-wealth, equal one when \$60,000≤*PROFIT*<\$972,000. The regression results for model (3) are such that the bank credit variable, *LOANS/SALES* is not significant for the high-wealth firms, but is positive and significant for the low-wealth firms, as predicted by Burkart and Ellingsen. Model 3 also finds the predicted negative relationship between bank loans and trade credit usage for the medium-wealth firms, but the estimated coefficient is not significant. Indeed none of the coefficients estimates for medium-wealth firms are statistically different from zero in model 3.

Thus, model 1 appears to be the most consistent with the theoretical predictions and its key findings hold under many different wealth thresholds and other robustness tests discussed in section 6.3 below.

6.2 Trade credit supplied and net trade credit regression results

Table 5 presents the estimates for the trade credit supply model and Table 6 presents findings from the net trade credit regressions.[12] In all the regressions in Table 5, the dummy variable for low-wealth is negative and significant, implying that those firms supply proportionally less trade credit than wealthier firms, as one might expect. One of the main implications of the Burkart and Ellingsen model with respect to *AR/SALES* is that faster-growing firms provide less trade credit than slower-growing firms. This hypothesis is quite clearly rejected by the data here since the coefficient on sales growth has a positive sign in all the regressions, as do the interaction terms, *LOWxGROWTH* and *MEDxGROWTH*. The sample firms here increase trade credit relative to sales as sales growth increases, but the coefficients are very small and not economically significant.

The author does find that increases in bank credit correspond to significant increases in *AR/SALES*. This positive relationship is consistent with Burkart and Ellingsen's argument that firms use trade credit claims to obtain more bank credit, although that implies the causality goes from *AR/SALES* to *LOANS/SALES*. Another possible interpretation is that as firms obtain more bank credit, they pass some of it on to their credit-rationed customers via trade credit, consistent with most of the financing theories of trade credit and other empirical studies. Surprisingly, however, *LOWxLOANS/SALES* is positive and significant at the 10% level, which means that the low-wealth firms provide proportionally more trade credit for a given increase in their bank credit than other firms. Since Petersen and Rajan (1997) find similar results, the author explores this issue further in the robustness tests described below.

12. The regressions reported in Tables 5 and 6 are based on the same wealth thresholds as those in Table 4.

Table 5. Trade credit supplied regression results fixed effects regressions

Dependent variable is *AR/SALES*	(1)		(2)		(3)	
	Low-wealth threshold		No wealth thresholds		Low- and high-wealth thresholds	
	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
LOANS/SALES	0.0457***	7.50	0.0508***	10.41	0.0402***	4.45
CAPEX$_{t-1}$/SALES$_{t-1}$	1.88e04***	3.65	2.46e04***	2.80	0.0054*	1.66
PROFIT/SALES	7.28e06	0.16	-1.89e06	-0.94	-3.63e05	-0.79
COV	-1.41e06	-1.00	-2.39e06	-1.41	-1.30e06	-0.92
SALES SHOCK	-1.63e08***	-3.89	-1.58e08***	-3.78	-1.63e08***	-3.88
GROWTH	7.21e07***	6.53	7.23e07***	6.52	8.28e07***	33.66
LOW WEALTH DUMMY	-0.0056***	-5.73			-0.0053***	-2.94
LOWxLOANS/SALES	0.0117*	1.80			0.0180*	1.86
LOWxCAPEX$_{t-1}$/SALES$_{t-1}$	2.56e04	0.99			-0.0050	-1.52
LOWxPROFIT/SALES	-3.94e05*	-0.77			5.19e06	0.10
LOWxCOV	-3.53e05*	-1.88			-3.51e05*	-1.91
LOWxSALES SHOCK	-2.98e09**	-1.97			-3.21e09**	-2.07
LOWxGROWTH	1.59e06*	1.64			1.64e06*	1.76
MED. WEALTH DUMMY					-0.0004	-0.22
MEDxLOANS/SALES					0.0095	0.94
MEDxCAPEX$_{t-1}$/SALES$_{t-1}$					-0.0053	-1.61
MEDxPROFIT/SALES					0.0018	1.44
MEDxCOV					-3.03e06	-0.20
MEDxSALES SHOCK					-1.93e09	-0.16
MEDxGROWTH					-6.84e07***	-2.91
Adjusted R-squared	0.7565		0.7572		0.7573	

Notes: Wealth thresholds are the same as those used for *AP/SALES* regressions. See notes to Table 4. The subset of data selected represent 72,291 observations of 28,749 firms.

Table 6. Net trade credit supplied regression results fixed effects regressions

Dependent variable is *(AR-AP) /SALES*	(1)		(2)		(3)	
	Low-wealth threshold		No wealth thresholds		Low- and high-wealth thresholds	
	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
LOANS/SALES	0.0639***	8.02	0.0508***	7.84	0.0546***	5.05
CAPEX$_{t-1}$/SALES$_{t-1}$	1.36e04***	3.01	3.07e05	0.14	0.0026	0.51
PROFIT/SALES	-1.29e04	-1.60	3.63e06	0.09	-1.45e04*	-1.64
COV	1.21e06	1.11	1.10e06	1.01	1.25e06	1.15
SALES SHOCK	-3.29e09	-1.44	-2.62e09	-1.23	-3.32e09	-1.45
GROWTH	9.66e08***	2.81	1.04e07***	3.03	9.40e08***	3.60
LOW WEALTH DUMMY	-0.0074***	-6.13			-0.0139***	-6.28
LOWxLOANS/SALES	-0.0209***	-2.46			-0.0099	-0.84
LOWxCAPEX$_{t-1}$/SALES$_{t-1}$	-3.27e04	-0.27			-0.0028	-0.53
LOWxPROFIT/SALES	1.55e04*	1.68			1.69e04*	1.70
LOWxCOV	-4.71e06	-0.45			-4.11e06	-0.39
LOWxSALES SHOCK	-1.32e09	-0.88			2.35e10	0.16
LOWxGROWTH	2.74e07	0.35			4.25e07	0.56
MED. WEALTH DUMMY					-0.0080***	-3.65
MEDxLOANS/SALES					0.0165	1.25
MEDxCAPEX$_{t-1}$/SALES$_{t-1}$					-0.0025	-0.48
MEDxPROFIT/SALES					1.08e05	0.05
MEDxCOV					-1.60e05	-1.28
MEDxSALES SHOCK					-3.19e09	-0.25
MEDxGROWTH					4.02e09	0.02
Adjusted R-squared	0.6881		0.6890		0.6892	

Notes: Wealth thresholds are the same as those used for AP/SALES regressions. See notes to Table 4. The subset of data selected represent 72,291 observations of 28,749 firms.

It was argued earlier that the Burkart and Ellingsen model's hypotheses could be extended to generate testable predictions for net trade credit. Specifically, the bank credit variable is expected to have a positive influence on the net trade credit to sales ratio for medium-wealth firms, and to have a negative or zero coefficient for the low-wealth firms. The regression results in Table 6 provide considerable support for this prediction, since the coefficient on *LOANS/SALES* is positive and highly significant, consistent with the prediction for medium-wealth firms. Also in model 1, the coefficient for *LOWxLOANS/SALES* is negative and significant, so there is a significant difference from the other firms. This difference implies that medium-wealth firms increase net trade credit more for a given increase in bank credit than low-wealth firms do. Nevertheless, the estimated coefficient for bank loans for the low-wealth firms is 0.0430, contrary to the prediction of a negative or zero coefficient. The trade credit supply and net trade credit regressions provide some support for the hypotheses generated by the Burkart and Ellingsen model, especially with respect to medium-wealth firms.

6.3 Robustness tests

Although there are no explicit predictions about the trade credit behaviour of firms that may be financially distressed in the Burkart and Ellingsen model, Petersen and Rajan (1997) find that distressed firms offer proportionally more trade credit than other firms. The author finds something similar for growing firms with low-wealth in Table 5. To compare the present findings more directly with Petersen and Rajan, the author also estimates the basic model (no wealth thresholds) for firms with negative sales growth and distressed firms. Distressed firms are defined as those with negative sales growth and negative profit. These results are reported in Table 7. In columns 1 and 3, trade credit usage increases as bank credit increases for both the declining and distressed firms. This is not surprising since declining and distressed firms are likely to be constrained in their access to both bank and trade credit, leading to a complementary relationship between the two types of credit as in the earlier findings for low-wealth firms.

With respect to trade credit supplied, the *AR/SALES* regressions indicate that both declining and distressed firms increase their trade credit supplied when their bank loans increase. This finding is consistent with Petersen and Rajan but is surprising, especially for the distressed firms. Firms that are in trouble might decrease the trade credit they provide if bank credit declines, but one would not expect them to increase their supply of trade credit if their access to bank credit improved. Wilner (2000) provides a potential explanation. Customers of distressed suppliers may have high market power such that dependent trade creditors are required by their large customers to provide credit even in periods of financial distress. A financially distressed supplier may be distressed because its largest customers are distressed. Wilner predicts that large, financially distressed customers prefer trade credit from a dependent supplier to credit from sources that are less dependent on them for future profits. The sample data here may be picking up on the kind of exploitation of market power predicted in Wilner's model.

Table 7. Trade credit usage and trade credit supplied regression results for declining and distressed firms, fixed effect regressions

Dependent variable	Declining firms (growth<0)		Distressed firms (growth<0 and profit<0)	
	AP/SALES	*AR/SALES*	*AP/SALES*	*AR/SALES*
	(1)	(2)	(3)	(4)
LOANS/SALES	0.0280***	0.0450***	0.0229	0.0396***
	(-3.23)	(5.68)	(1.31)	(2.56)
CAPEX$_{t-1}$/SALES$_{t-1}$	0.0077	0.0168*	-0.0036	0.0053
	(0.76)	(1.78)	(-0.19)	(0.41)
PROFIT/SALES	-1.39e05	-4.50e06	-0.0003**	-1.67e06
	(-1.47)	(-1.45)	(-2.08)	(-0.30)
COV	-2.34e06	2.30e06	3.98e06	6.98e06
	(-0.81)	(0.99)	(0.30)	(0.48)
SALES SHOCK	-1.69e08**	-8.85e09*	-1.10e07***	-4.08e08*
	(-2.38)	(-1.68)	(-3.67)	(-1.70)
GROWTH		-5.87e04***		-3.88e04***
		(-10.90)		(-3.79)
Number of observations	49,648	49,648	21,216	21,216
Number of firms	24,354	24,354	13,196	13,196
Adjusted R-squared	0.6016	0.6845	0.6266	0.7157

Note: t-statistics shown below in parentheses. See notes to Table 4.

Table 8. Robustness Tests, fixed effects regressions

Dependent variable	Weighted observations		Including industry dummy variables		Clustered standard errors	
	AP/SALES	*AR/SALES*	*AP/SALES*	*AR/SALES*	*AP/SALES*	*AR/SALES*
	(1)	(2)	(3)	(4)	(5)	(6)
LOANS/SALES	-0.0287***	0.0517***	-0.0181***	0.0458***	-0.0181	0.0457***
	(-2.46)	(5.11)	(-2.50)	(7.50)	(-1.62)	(5.53)
CAPEX$_{t-1}$/SALES$_{t-1}$	-2.54e05	1.84e05***	5.16e05	1.86e04***	5.26e05	1.88e04***
	(-0.66)	(4.91)	(0.66)	(3.70)	(0.51)	(2.83)
PROFIT/SALES	4.06e04***	-1.59e06	1.38e04	7.58e06	0.0014	7.28e06
	(2.62)	(-0.02)	(1.52)	(0.16)	(1.10)	(0.13)
COV	-3.44e06**	-2.31e06	-2.61e06**	-1.41e06	-2.62e06*	-1.41e06
	(-1.99)	(-1.48)	(-2.23)	(-1.00)	(-1.93)	(-1.10)
SALES SHOCK	-1.32e06***	-1.61e08***	-1.30e08***	-1.66e08***	-1.31e08**	-1.63e08**
	(-3.94)	(-3.75)	(-4.25)	(-3.87)	(-2.32)	(-2.20)
GROWTH		6.90e07***		7.33e07***		7.21e07***
		(4.85)		(6.36)		(5.02)
LOW WEALTH DUMMY	0.0065***	-0.0029*	0.0017	-0.0057***	0.0017	-0.0056***
	(3.41)	(-1.73)	(1.52)	(-5.80)	(1.18)	(-4.43)
LOWxLOANS/SALES	0.0422***	7.17e04	0.0333***	0.0120*	0.0327***	0.0117
	(3.21)	(0.07)	(4.53)	(1.84)	(3.21)	(1.36)
LOWxCAPEX$_{t-1}$/SALES$_{t-1}$	2.00e04	6.88e04	5.98e04	2.62e04	0.0060	2.56e04
	(0.19)	(0.67)	(0.57)	(1.01)	(0.93)	(1.19)
LOWxPROFIT/SALES	-5.02e05***	5.43e05	-1.99e04*	-3.96e05	-1.93e05	-3.94e05
	(-2.81)	(0.65)	(-1.94)	(-0.77)	(-1.44)	(-0.58)
LOWxCOV	-5.20e05***	-1.53e05	-3.04e05	-3.52e05*	-3.06e05	-3.53e05
	(-2.45)	(-0.74)	(-1.55)	(-1.88)	(-1.13)	(-1.41)
LOWxSALES SHOCK	-3.45e09	-6.85e09***	-1.54e09	-3.00e09**	-1.61e09	-2.98e09*
	(-1.48)	(-2.83)	(-0.82)	(-1.97)	(-0.62)	(-1.80)
LOWxGROWTH		-1.76e06		1.59e06*		1.59e06
		(-0.64)		(1.65)		(1.22)
Adjusted R-squared	0.7383	0.7987	0.6583	0.7574	0.6580	0.7572

Notes: t-statistics shown below in parentheses. Models 3 and 4 include 54 industry dummy variables based on 2-digit SIC codes. Models 5 and 6 assume clustering of standard errors occurs at the firm level. See notes to Table 4. The subset of data selected represent 72,291 observations of 28,749 firms.

To further test the robustness of the main findings, the author also analyzes several modified versions of regression model 1 in Tables 4 and 5. Table 8 reports the results of estimating the main trade credit usage and supply regressions with weighted observations, dummy variables for industry, and controls for clustered standard errors. Weighted data can help adjust for the stratified sampling methods used to collect some of the data. Industry-specific trade credit terms, and other industry-specific factors may be better controlled for with the addition of industry dummy variables. Finally, if the data are independent across firms but not necessarily independent over time within firms, controlling for clustering in the data may be appropriate. This correction increases the standard errors in the coefficient estimates and therefore reduces the t-statistics.

The results of these robustness tests are generally quite similar to the findings presented for model 1 in Tables 4 and 5. Regressions with weighted observations have somewhat larger coefficients for the bank credit variables in the *AP/SALES* regressions. Adding industry dummy variables makes almost no difference to any of the coefficients. Correcting for clustered standard errors reduces the precision of the coefficient estimates and weakens the findings somewhat. Specifically *LOANS/SALES* in column (5) is no longer statistically significant, although the coefficient on *LOWxLOANS/SALES* remains significant.

7. Conclusion

Burkart and Ellingsen (2004) model trade credit as means to help overcome a potential moral hazard problem of borrowers diverting resources for private gain. This problem causes credit rationing of both bank credit and trade credit, but because inputs are harder to divert than cash and suppliers have a monitoring advantage for input use, suppliers can provide credit when banks cannot. Their model explains why firms of different wealth categories face different degrees of credit rationing and have different trade credit usage patterns. Aggregate investment is higher when trade credit is available because it allows medium- and low-wealth firms to invest more than their bank credit constraint would permit.

The findings here on trade credit usage provide fairly strong support for the theory's main predictions particularly with respect to medium-wealth firms. For the medium-wealth firms, bank credit and trade credit usage is negatively related, consistent with trade credit playing the role of less desirable substitute form of credit when bank credit is exhausted. These firms can increase their reliance on trade credit if bank credit becomes less available. The firms identified as low-wealth have a positive, complementary relationship between their bank credit and trade credit use, suggesting they are constrained in both trade credit and bank credit markets. The findings on trade credit usage seem robust to a large range of possible wealth thresholds. Nevertheless, the estimated effects for the low- and medium-wealth firms here appear to be economically small despite their strong statistical significance.

The findings also suggest that there are very few high-wealth, unconstrained firms in Canada. This is consistent with Nilsen (2002) who finds that all but the largest, bond-rated firms appear to be finance-constrained. The data do not seem to support the view that firms supply less trade credit when their investment opportunities increase insofar as sales growth captures investment opportunities. The author finds that faster sales growth corresponds to provision of more trade credit. Consistent with Petersen and Rajan (1997), The author also finds that low-wealth, declining and distressed firms provide proportionally more trade credit than more wealthy firms do. Further research that employs better proxies for creditor vulnerability and trade credit interest rates than are available for this study. Further empirical work to discover why distressed firms supply more trade credit than other firms, and the cyclical implications of this behaviour would also be of interest.

Appendix: Variable definitions and data description

Variable	Description
Accounts payable (*AP*)	Accounts Payable from Trade (arising from sale of goods and services) measured in 1997 Canadian dollars. Nominal values converted to real using the GDP deflator.
Accounts receivable (*AR*)	Accounts Receivable from Trade (arising from purchase of goods and services), measured in 1997 Canadian dollars.
Net trade credit	*AR – AP*
Sales	Sales of goods and services in 1997 dollars.
Profit	Net Income after all items have been included (taxes, income from affiliates, extraordinary items etc.), measured in 1997 dollars.
Loans	Loans from Non-Affiliates in 1997 dollars.
Capital expenditure	Net Capital Expenditures, measured in 1997 dollars.
Coverage ratio (*COVRATIO*)	Earnings Before Interest and Taxes (EBIT) / Interest Expense on Debt, where EBIT is calculated as Net Profit Before Tax + Interest Expense on Debt
Growth	Percentage change in sales from previous year.
Sales shock	Residual from auxiliary OLS regression of sales on a constant and year dummies and industry dummy variables.

Data description

The data come from Statistics Canada's unpublished microdata files of the Financial and Taxation Statistics for Enterprises (FTSE) annual database. The FTSE is a detailed database of balance sheet, income statement and corporate income tax data. The dataset contains enterprise-level data that are collected using a combination of survey data and administrative data from corporate tax returns provided to Statistics Canada from Canada Revenue Agency (CRA). The sample is stratified three ways: by industry, by country of control, and by size. Industries are defined using 63 groupings of the 1980 2-digit SICs.[13] Within each industry there are three strata based on whether the firm's country of control is Canada, the United States or another country. Finally, within the country of control stratum, there are multiple size categories based on the firm's assets or revenues. The largest firms in each industry are sampled with certainty, although the size bounds vary by industry. For most industries this "take-all" stratum consists of the largest firms with assets or annual revenues of more than $25 million in current dollars. The second "take-some" strata consists of smaller firms that are randomly selected for inclusion in the survey. In the take-some stratum, data were collected through a mix of surveys and

13. This survey used a non-standard SIC system called SIC-C 14. This refers to the Canadian SIC for Companies and Enterprises and it is intended to categorize companies based on their activities.

administrative tax files. The final stratum of the sample consists of the smallest firms which were not surveyed, so all their data come from the tax return files.

The author selects only the non-financial firms from the dataset, and also removes observations from the sample if regression variables seem to have very extreme values. Specifically, the author restricts the sample to those observations where the dependent variables in the regressions, the accounts payable to sales and accounts receivable to sales ratios, were between zero and one; this removes approximately 1% of the original observations. Observations where sales are negative are also omitted, as are the cases where ratios of capital expenditures to sales or bank loans to sales were zero or greater than the 95^{th} percentile value.

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