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Trade Credit and the Propagation of Corporate Failure: An Empirical Analysis*

Tor Jacobson[†] Erik von Schedvin[‡]

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Abstract

We quantify the importance of trade credit chains for the propagation of corporate bankruptcies. Our results show that trade creditors (suppliers) that issue more trade credit are more exposed to trade debtor (customer) failures, both in terms of the likelihood of experiencing a debtor failure and the loss given failure. We further document that the credit loss invoked by a debtor failure imposes a substantially enhanced bankruptcy risk on the creditors. The propagation mechanism is mitigated for creditors that are less levered, cash rich, and highly profitable, and enhanced in $R\&D$ intense industries and during economic downturns.

Keywords: Trade credit; Credit chains; Bankruptcy; Contagion

JEL: G30; G33

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1 Introduction

By issuing trade credit, firms provide short-term financing to their customers (see, e.g., Petersen and Rajan 1997). In most countries, trade credit is an instrumental component of firms' capital structure (Raddatz 2010). Rajan and Zingales (1995) document that the average amount of accounts payable to total assets is around 15 percent for a sample of U.S. firms and we find a corresponding average for Swedish corporate firms of around 13 percent (see Table 2). The amount of accounts payable can be compared with regular short-term bank financing to total assets for U.S. and Swedish corporate firms averaging 7 and 5 percent, respectively.[1] This suggests that trade credit weakly dominates short-term bank financing in sheer size and importance in both U.S. and Sweden. The empirical literature on trade credit has so far emphasized the role of liquidity provision and insurance, but largely ignores the credit risk aspects. This paper aims at shedding more light on the latter.

At the micro level, inter-firm linkages introduced by trade credit are potentially important carriers of credit risk between firms. A trade debtor (customer) in bankruptcy will almost surely default on the claims held by the trade creditors (suppliers), and thus exert a credit loss on them. This loss could, in turn, push the trade creditors into financial distress and subsequent bankruptcy. Recent survey evidence — for a sample of U.S. firms — lists non-payments by trade debtors as the prime cause of financial distress and bankruptcy (see Bradley and Rubach 2002), highlighting the credit risk firms face when issuing trade credit. At the macro level, the inter-firm linkages imposed by the widespread use of trade credit implies that it potentially is an important channel through which aggregate shocks are transmitted and amplified in the economy.[2]

[1] In this context it is also relevant to consider bank lines of credit. One of the largest Swedish retail banks display commited-credit-lines-to-assets averaging 15 percent and drawn-credit-lines-to-assets averaging 6 percent for the period 2003 to 2008, see Degryse, Ioannidou, and von Schedvin (2012) for details on that data set. Sufi (2009) report very similar numbers for a sample of US firms: 16 percent for committed-credit-lines-to-assets and 6 percent for drawn-credit-lines-to-assets. Trade credit volumes are thus comparable to regular short-term bank credit volumes even when measuring the latter broadly.

[2] See, for example, Kiyotaki and Moore (1997), Cardoso-Lecourtois (2004), Boissay (2006), and Battiston,

Although the credit chains induced by trade credit are likely to propagate corporate failures and exacerbate aggregate shocks, there is limited empirical work exploring this presumption, most likely due to data limitations. The existing empirical evidence is on the financial side or indirect. Hertzel, Li, Officer, and Rodgers (2008) show that suppliers of goods to firms that enter financial distress experience negative stock price returns around the distress date. Boissay and Gropp (2007) explore the liquidity insurance aspect of trade credit and document that firms are likely to postpone their own trade credit payments as a response to late payments by their trade debtors. Furthermore, Radatz (2010) shows that an increased usage of trade credit, linking two industries together, is associated with a higher output correlation between the industries. Taken together, these empirical findings support the trade credit propagation hypothesis. However, there is a gap in the existing literature regarding direct empirical evidence on the role of trade credit for the propagation of corporate failures, which is the concern of this paper.

Towards this end, we have compiled a vast data set for the universe of Swedish corporate firms over the period 1992 to 2010, based on their yearly accounting statements. In addition, we have precise information on suppliers and customers from a trade credit perspective, their bankruptcy dates, and the sizes of the claims involved. Thus, we know whether a firm, in its role as a trade creditor, experienced a trade debtor failure, when it happened, and the size of the claim. This data set provides an opportunity to empirically gauge the risks associated with trade credit issuance. We do this along two dimensions. Firstly, we relate the issuance of trade credit to the likelihood of experiencing a trade debtor failure, and the size of the loss given failure. This initial exercise quantifies the credit risks involved in trade credit. Secondly, we then explore the bankruptcy risk that a trade debtor failure imposes on its trade creditors. The later exercise provides insights on the importance of trade credit chains for the propagation of corporate failures.

Gatti, Gallegati, Greenwald, and Stiglitz (2008) for theoretical work along these lines.

The main results can be summarized as follows. Our descriptive statistics show that the annual fraction of firms that experience at least one trade debtor failure is around 9 percent over the sample period; hence, the credit losses resulting are a frequent phenomenon. 19 percent of the bankrupt firms experienced a trade debtor failure around their bankruptcy event, which suggests that the credit losses are not negligible in effect. The fraction of bankrupt firms that experienced a trade debtor failure is higher during economic downturns. An extreme example is the Swedish banking crisis in the early 1990s where we observe that 33 percent of the bankruptcies were associated with a trade debtor failure. These descriptive results suggest that the credit chain propagation mechanism described in Kiyotaki and Moore (1997) is at play. The inter-firm linkages imposed by trade credit give rise to and propagate credit losses throughout the economy.

In this vein, controlling for firm-specific characteristics, we document that firms that issue more trade credit have a higher likelihood of experiencing a trade debtor failure, and are also exposed to larger trade credit-related losses. Not surprisingly, our results confirm that trade debtor failures induce a substantially enhanced bankruptcy risk on trade creditors. We estimate an average marginal effect implying an increase in annual creditor failure risk by around 2 percentage points when hit by a debtor failure. In comparison with the average unconditional annual failure risk of 2 percent, a trade debtor failure thus increases creditor failure risk by 100 percent at the mean. We also show that this risk is increasing in the size of the trade credit losses.

Based on a set of robustness tests we conclude that creditors increased failure risk is mainly driven by the credit losses following debtor failures. More specifically, we challenge this baseline result by exploring to which extent common shocks and demand shocks offer alternative explanations. However, controlling for combinations of time-, industry-, and location-fixed effects, we find no support that the risk imposed on the trade creditor through a trade debtor failure is due to a spurious correlation arising from a common shock that simultaneously hit both firms. In contrast, demand shocks — to a degree — play a role. We find that the propagation mechanism is enhanced in $R\&D$ intense industries where supplier-customer relationships are expected to be more important, i.e., for such creditors involved in the production of specialized goods and services making them more vulnerable to shortfalls in demand. Nevertheless, although demand shocks matter, overall our robustness analysis shows that the enhanced risk mainly is driven by the credit losses.

There are several important cross-sectional determinants of trade debtor failure induced bankruptcy risk. Firstly, the credit loss imposed by a trade debtor failure implies that the value of the creditor's assets is reduced. A trade debtor failure may thus push the creditors into balance-sheets-based insolvency, i.e., the value of the liabilities exceeds that of the assets. Accordingly, we find that the propagation mechanism is enhanced for highly levered firms. Secondly, the credit loss imposes a shock to the creditor's liquidity holdings. Thus, if the credit loss is sufficiently large then it may push the creditor into cash-flow-based insolvency, i.e., a shortage of liquid assets to cover debt payments and ongoing expenditures. Along these lines, Kiyotaki and Moore (1997) predict that firms with "deep pockets" (cash rich) and high cash flows are less exposed to a trade debtor failure. Consistent with these predictions we show that the propagation mechanism is mitigated for creditors that are cash rich and highly profitable. Finally, we document that the risk imposed by a trade debtor failure is counter-cyclical, increasing in economic downturns.

Our paper is closest related to that by Boissay and Gropp (2007). They work with a similar data set and document that trade creditors are likely to respond to late trade debtor payments by, in turn, postponing their own trade credit payments. A liquidity shock is shown to be transmitted along the trade credit chain until it reaches a trade creditor with access to external financing and the ability to absorb the liquidity shock. This important result suggests that trade credit chains function as an insurance mechanism by allocating liquidity from unconstrained to constrained firms. However, unlike the present paper, their empirical analysis does not provide direct insights on the propagation of corporate bankruptcies through trade credit.

The results in this paper are further related to the trade credit literature by rationalizing the pricing of trade credit contracts. More specifically, as documented by Boissay and Gropp (2007), trade creditors provide liquidity insurance to their debtors. Cuñat (2007) suggests that the creditors price the insurance mechanism, which explains the high implicit interest rates of trade credit. Our results show that trade credit issuance is frequently associated with credit losses. Thus, credit risk is an additional factor that is likely to be incorporated in the pricing of trade credit contracts, explaining why trade credit appears so expensive.

A somewhat more general take on the importance of a trade credit channel and trade debtor failure triggered credit losses for corporate failures is (indirectly) suggested by Das, Duffie, Kapadia, and Saita (2007). They ask the question why corporate defaults cluster in time, and note that one candidate explanation is default contagion. Das et al. empirically test whether there is evidence for excess default correlation, over and above that implied by the correlation of firms' risk factors determining their conditional default probabilities. The tests are, in general, rejected for models taking account of idiosyncratic as well as common risk factors, but not of contagion per se. Our results suggest that trade credit shocks capture default contagion and could well be the missing link explaining corporate failure clustering.

The remainder of this paper is structured as follows. The next section details our data resources, the institutional setting, and provides some descriptive statistics. The empirical results are presented in Section 3. We will first address the relationship between use of trade credit and trade debtor failure risk, and then examine losses given trade debtor failure. We then tackle bankruptcy risks for trade creditors imposed by trade debtor failures and also examine cross-sectional determinants of these risks. Section 4 concludes.

2 Data, Institutional Setting, and Descriptive Statistics

In this section we first outline the data that we explore in the empirical section and describe the institutional setting with a focus on the Swedish bankruptcy code. We then proceed by providing descriptive statistics that highlight the risks that trade debtor failures impose on trade creditors.

2.1 Data and institutional setting

From the leading Swedish credit bureau, Upplysningscentralen AB (UC), we obtain records of corporate firm bankruptcies, over the period 1992 to 2010. According to Swedish bankruptcy code, either the firm itself or any individual creditor can file for bankruptcy.[3] The bankruptcy case is filed to a district court, which will initiate the bankruptcy procedure if the firm is insolvent and if it is highly unlikely that the firm will become solvent again within a near future. If the court approves the bankruptcy filing then control rights are immediately transferred from the firm's management to a court-appointed trustee. The trustee continues the bankruptcy process by constructing an inventory of the firm's assets and liabilities. The assets are then auctioned off and the creditors' claims are covered according to absolute priority rights, and with no priority deviations being allowed. According to the absolute priority rights, trade credit is classified as unsecured junior debt and has the lowest priority. This priority order implies that recovery rates for unsecured junior creditors are extremely low, for example, Thorburn (2000) documents that the average (median) recovery rate for unsecured junior creditors is around 2 (0) percent in Sweden. In order to measure bankruptcy we adopt the following natural definition of a firm failure. A firm has failed if declared bankrupt in a legal sense, i.e., a liquidation decision by court ruling. This bankruptcy measure thus capture firm events similar to those underlying US Chapter 11 filings for bankruptcy.

Beside the data set on bankruptcy events, we also obtain data containing information on all

[3] See Thorburn (2000) for a comprehensive overview of the Swedish bankruptcy code.

individual claims, exceeding SEK 5,000 (approximately USD 700), that are held on bankrupt firms by unsecured junior creditors (trade creditors), over the period 1992 to 2010. The credit bureau collects this information from reports that the court-appointed trustees provide to the bankruptcy court and the provincial supervisory authority "Tillsynsmyndigheten i Konkurs" (TSM). A majority of these claims corresponds to corporate bankruptcies (around 80 percent) and the residual part mainly corresponds to claims held on bankrupt sole proprietorships (around 20 percent). The dataset contains information on the date of the trade debtor bankruptcy and the identity of the trade creditors. However, we do not observe the identity of the bankrupt trade debtor for most of the sample period, but do so for the sub-period 2007 to 2010. In the period 1996 to 2010 we also observe the size of the claims held by the trade creditors on bankrupt trade debtors. We use this information to construct our key variable, i.e., the variable that indicates whether, or not, a firm has experienced a trade debtor failure.

Insurance contracts providing protection against trade debtor failures are not common in Sweden; possibly due to the moral hazard problem that such contracts introduce by altering firms' motives to avoid trade debtor failures. A possibly confounding factor is factoring firms' operations that have become a prosperous industry in Sweden. They allow suppliers to borrow against their accounts receivable as collateral, or alternatively, but much less frequent, will purchase the claims on trade debtors. Only if a supplier sells an invoice will the ownership of the claim be transferred to the factoring firm, and would, conditional on a trade debtor failure, the factoring firm appear as a trade creditor in our data set. However, we note that factoring firms are remarkably infrequent trade creditors, most likely due to the thorough screening process they undertake before purchasing trade credit claims, and thereby avoiding high risk trade debtors. Nevertheless, in the empirical analysis we exclude factoring as well as other financial firms.

The credit bureau has also provided us with data on accounting statements and balance sheet information for all Swedish corporate firms during the period 1989 to 2010. This information is collected by the credit bureau from the Swedish Companies Registration Office (SCRO).[4] In Sweden, as in many other countries, firms have considerable discretion in choosing a fiscal year period for their financial statements. For a large fraction of the firm-year observations in our sample the fiscal year starts in the middle of the calendar year. We deal with this by interpolating the financial statements such that they correspond to the calendar year.[5] Moreover, from the SCRO we obtain data on corporate registration dates which we use to determine the age of the firms.

We construct an industry classification based on one-digit SNI codes (equivalent to U.S. SIC codes) obtained from the accounting statements. Financial firms and utilities are omitted since these firms are subject to regulations. We also omit firms where information on industry belonging is missing.[6] Since the focus of the paper is on the role of trade credit issued for commercial purposes, we further restrict our sample to firms with real sales and assets exceeding SEK 100,000 (deflating by means of consumer prices, with year 2000 prices as base-line).[7] Furthermore, a small fraction of the financial ratios in our sample is made up of severe outliers. In order to make sure that our results are not distorted by such outliers we have chosen to truncate the financial ratios according to common practise, see, e.g., Shumway (2001). The applied truncation limits for each financial ratio are reported in Table 2.

[4] Swedish law requires every corporate to submit an annual financial statement to the SCRO, covering balance sheet and income statement data in accordance with EU standards. Moreover, every corporate is also required by Swedish law to hold in equity a minimum of SEK 100,000.

[5] See Jacobson, Giordani, von Schedvin, and Villani (2011) for a detailed overview of the applied interpolation procedure. The shares of shorter (less than 12 months) and longer (longer than 12 months) statements are both around 5 percent. Whereas shorter than the stipulated 6 months happen, statements covering a longer period than the allowed 18 months are very rare. Over time, the annual shares of shorter/longer statement periods have come down from about 8 percent to currently around 4 percent. Thus, an overwhelming majority of statements concern a period of 12 months. However, out of the 90 percent of the total number of statements, only 48 percentage points coincide with a calendar year, and hence 42 percentage points refer to other 12 month periods. In these calculations we have allowed for a given calendar year to begin in mid-December the previous year, and end in mid-January the following year.

[6] The corpotate firms that we consider belong in one of the following industries: agriculture, manufacturing, construction, retail, hotel and restaurants, real estate, transports, and consulting and rental.

[7] SEK 100,000 corresponds to around USD 14,000.

2.2 Descriptive statistics

Table 1 reports descriptive statistics for our key variables. Column (I) shows the average amount of accounts receivable to total assets in each year during the sample period. The average yearly amount of trade credit issued vary around 15 to 18 percent, possibly declining somewhat over time from averages around 18 percent in the early years towards less than 16 percent for the end of the period. Column (II) reports the aggregate bankruptcy frequency for the Swedish corporate sector. There are considerable swings in the bankruptcy frequency overall, but these tend to become dwarfed by the Swedish banking crisis episode in 1992 to 1993. The crisis period displays bankruptcy rates around 5 percent, as compared with the overall rate of 2 percent for the entire sample period. Column (III) reports the trade debtor bankruptcy frequency, corresponding to the fraction of firms that in a year face one, or more, trade debtor failures. The trade debtor bankruptcy frequency is higher than the bankruptcy frequency since each bankrupt firm on average obtained trade credit from more firms than one. For the sub-period 2007 to 2010 we observe that the average (median) number of trade creditors for a bankrupt trade debtor is around 8 (4). Figure 1 shows that the yearly fraction of firms that faced a trade debtor failure is highly correlated with the overall bankruptcy frequency, thus the fraction of firms that faced a trade debtor failure was substantially larger during the crisis period (around 16 percent). However, for the sub-period 1994 to 2004 we see that the trade debtor failure frequency remains elevated and the tight link with the regular bankruptcy rate is resumed towards the end of our sample period.

[Insert Table 1 about here.]

[Insert Figure 1 about here.]

Column (IV) reports the total amount of claims held by trade creditors on failed trade debtors. Given that the recovery rate for trade creditors is close to zero (Thorburn 2000), the reported claims are a good approximation of the aggregate credit losses trade debtor failures induce on trade creditors. The average yearly amount of claims over the period 1996 to 2010 is SEK 2.2 billion, which is sizable. An interesting comparison with Swedish banks' total credit losses on loans of all maturities to non-financial firms can be made for the period 2004 to 2010. These credit losses are presented in Column (V) and roughly amount to half of the trade credit losses. Hence, it is quite clear that trade credit losses are quantitatively important. Column (VI) shows that for a supplier conditional on having experienced a trade debtor failure; the size of the bankruptcy claim-to-assets (for the creditor firm) is on average 2.2 percent, and claims are also slightly higher in the bust period, 2001 to 2003, following the IT boom.

The purpose of Column (VII) is to provide initial descriptive statistics on how trade debtor failure affects the likelihood that a trade creditor fails. Thus, Column (VII) reports the fraction of bankrupt firms that experienced a trade debtor failure in the eleven months preceding or at any point in time after their bankruptcy event (see discussion below). Over the sample period, 18.6 percent of the bankrupt firm-years are associated with a trade debtor failure. This can be compared with the overall trade debtor failure frequency of 8.5 percent (Column (III)). The trade debtor failure rate is thus on average around 10.1 percentage points higher for the failing firm-years than for the non-failing firm-years. This highlights that trade debtor failure potentially is an important risk factor for firms. We can also see that the rate of bankrupt firm-years that are associated with a trade debtor failure fluctuates over the sample period. The rate is around 33 percent during the banking crisis and falls to around 10 percent towards the end of the sample period. Thus, the increased frequency during the crisis period suggests that trade debtor failures play an important role by amplifying idiosyncratic shocks during economic downturns. Moreover, Column (VIII) reports the average size of the bankruptcy claim-to-assets for the bankruptcy events that are associated with a trade debtor failure. The average size of the claim-to-assets is 9.7 percent, which is substantially higher than the 2.2 percent reported for firms in general (Column (VI)). Quite intuitively, this indicates that firms that have a large claim on a bankrupt trade debtor are more likely to fail as a consequence of the credit loss imposed by the debtor failure.

[Insert Figure 2 about here.]

In the data we observe cases where the bankruptcy date of a trade creditor precedes the bankruptcy date of its trade debtor. Panel A in Figure 2 shows the trade creditor and debtor failure timing for the period 2007 to 2010 (for which we observe the identity of the debtor). The figure is constructed using a sample where we select all creditor failures associated with a trade debtor failure in the eleven months prior to the creditor failure, or at any point in time after this event (month 0 corresponds to the creditor failure month). If a trade creditor experienced multiple debtor failures, we keep the failure with the largest bankruptcy claim. The figure shows that — conditional on a trade debtor failure — 69 percent of the bankrupt trade creditors experienced the debtor failure in the same month, or in the eleven months prior to their failure. 18 percent experienced the debtor failure in the six months after their failure, and 12 percent experienced the debtor failure more than six months after their failure. The main reason for the reverse timing is that it is common for bankrupt firms to default on their payments in the (occasionally very long) period running up to the actual bankruptcy event. If the size of the claim is sufficiently large, then the debtor's payment default may push the creditor into cash-flow-based insolvency and immediate bankruptcy, whereas it can take additional time before the debtor itself enters bankruptcy. Panel B shows that the average size of these claims to (creditor) assets is around 9 percent, which is substantially larger than the average claim-to-assets of 2.2 percent observed for all debtor failures (Column (VI) in Table 1). Thus, the size of the claims are substantial which makes it conceivable that a creditor that experiences a debtor payment default of this magnitude can get pushed into immediate bankruptcy.[8]

Our two key variables in the empirical analysis are dummy variables indicating whether, or not, a firm (possibly, but not necessarily a trade creditor) fails at time t, TCF, and whether or not a firm experienced a trade debtor failure at time t, TDF. We apply the following adjustments for trade debtor failures that take place around the creditor failure date. If we observe $TCF = 1$ for firm i in year t then we will set $TDF = 1$ if we observe a trade debtor failure at any point in time after the trade creditor bankruptcy month, or in the eleven months prior to the trade creditor bankruptcy, and $TDF = 0$ otherwise. For non-bankrupt trade creditor firm-years, i.e., for $TCF = 0$, we simply set $TDF = 1$ if we observe a trade debtor failure in year t, and to 0 otherwise. A trade debtor failure is never assigned to multiple years.

[Insert Table 2 about here.]

Table 2 reports descriptive statistics for a set of firm-specific variables that characterize the firms in this study. The table distinguishes between firm-years that were and were not associated with a trade debtor failure. We see that firms that experience a trade debtor failure on average issued more trade credit. Firms that experience a trade debtor failure have an average ratio of accounts receivable-to-assets of 25.9 percent as compared 15.9 percent for firm-years with no trade debtor failure involved. Thus, this highlights the credit risks firms face by issuing trade credit. Moreover, firms that experience a trade debtor failure are on average more leveraged, hold less cash and liquid assets, have less fixed assets, are larger, and are older. This is in line with findings previously reported in the trade credit literature showing that firms with better access to external financing issue more trade credit (see, e.g., Petersen and Rajan 1997; and Giannetti, Burkart, and Ellingsen 2011). Nevertheless, even if the firms that experience trade debtor failures on average are larger and older, their annual bankruptcy frequency is higher,

[8] Due to the low recovery rates for unsecure junior creditors it is not common practice that bankruptcy trustees enforce payments by filing for bankruptcy for the debtor. Thus, the close-to-zero recovery rate eliminates any concern for a reverse relationship.

4.9 as compared with 2.0 percent, which again indicates that credit imposed by a trade debtor failure potentially is an important risk factor. Finally, the average size of the trade debtor failure related claims-to-assets is 2.2 percent, which may appear as fairly modest. However, if we instead relate the size of these claims to the amount of accounts receivable we find that the average is 37.6 percent, suggesting that a trade debtor failure on average induces a sizable loss for the trade creditor.

3 Empirical Results

This section presents the empirical analysis. We will first address the relationship between issuance of trade credit and trade debtor failure risk, i.e., determine how issuance-volume of trade credit, creditor characteristics, and business cycle conditions quantitatively affect the likelihood of a trade creditor experiencing trade debtor failure. We will then examine trade credit losses given trade debtor failure, and in particular, the relationship between trade credit volume and the size of the claims held by a trade creditor on bankrupt trade debtors. We then proceed to the heart of the matter: modeling trade creditor bankruptcy risk conditional on trade debtor failure in order to quantify the propagation mechanism of trade credit risk. Finally, we perform a set of robustness checks and explore a set of cross-sectional determinants of the bankruptcy risk imposed by trade debtor failure.

3.1 The incidence and magnitude of trade debtor failures

The descriptive statistics reported in Table 2 suggest that firms that issue more trade credit are more exposed to trade debtor failures. To explore this relationship completely we would ideally require information on the number of firms that each trade creditor issues trade credit to, and the size of the claim to each debtor, as well as the debtors' characteristics. The number of trade debtors is presumably positively related to the likelihood that a creditor will experience a trade debtor failure and, of course, the size of a claim will ultimately determine the loss given failure. Unfortunately, we do not observe the number of trade debtors, nor the sizes of their individual claims. Nevertheless, accounts receivable is a measure of the total amount of trade credit issued by a trade creditor and an increasing function in both the number of debtors and in the sizes of their claims. Thus, by examining how accounts receivable affects the likelihood of experiencing a trade debtor failure — and the loss given failure — we can provide insights on firms' trade credit issuance and their subsequent credit losses.

3.1.1 The likelihood of experiencing a trade debtor failure

We explore how firms' credit issuance affects the likelihood of experiencing a trade debtor failure by estimating a logistic model where we regress the indicator variable $TDF_{i,t}$ — taking the value 1 if firm i experienced one (or more) trade debtor failure(s) in year t, and 0 otherwise — on the amount of trade credit issued by firm i in year $t-1$, and a vector of control variables, Z_i:

$$P\left(TDF_{i,t}=1\right)=\frac{1}{1+\exp\left(-\left(\alpha+\gamma\times accounts\ receivable/assets_{i,t-1}+\beta\times Z_{i,t-1}\right)\right)}. \qquad (1)$$

The vector Z_i includes a set of firm-specific variables and a set of industry- and time-fixed effects to control for cross-industry heterogeneity and business cycle fluctuations in the trade debtor failure frequency.

[Insert Table 3 about here.]

Column (I) in Table 3 reports coefficient estimates for an industry- and time-fixed effects regression where we regress the trade debtor bankruptcy indicator on firms' accounts receivable. The reported slope coefficient is positive and significant, 2.433, demonstrating that the risk of experiencing a trade debtor failure is increasing in the amount of accounts receivable. The effect of accounts receivable on the likelihood of experiencing a trade debtor failure is both statistically and economically significant. The average marginal effect yields an increase in the mean risk of experiencing a trade debtor failure by $(0.179 \times 0.185/0.085 =)$ 39 percent from a one-standard-deviation increase in accounts receivable. This result is evidence of a direct link between firms that issue more trade credit and their increased exposure to credit losses induced by trade debtor failures.

We will now empirically explore the assumed positive relationship between the likelihood that a creditor will experience a trade debtor failure and the number of customers that the firm issues credit to. To do so we augment Equation (1) by the natural logarithm of total assets of the trade creditor, both linearly and interacted with the accounts receivable variable. The rationale for this specification is that large firms — as compared with small ones — on average serve a larger number of customers and should therefore face an enhanced likelihood of experiencing a trade debtor failure. The interaction term is included to account for any potential relationship between firm size and issuance volume. The reported coefficient estimates in Column (II) are positive and statistically significant for both the log of total assets, 0.524, and for the interaction term between the log of total assets and accounts receivable, 0.238. Considering the linear term only, we can assess a lower bound for the economic significance of firm size. *Ceteris paribus*, the estimated average marginal effect yields more than a $(0.034 \times ln((23.4 + 631.7)/23.4)/0.085 =)$ 133 percent increased risk, at the mean, of experiencing a trade debtor failure from a one standard-deviation increase in total assets. Thus, these results highlight that the risk that a trade creditor will experience a debtor failure is strongly related to the size of the creditor, which we interpret as a relationship between the number of debtors the creditor extends credit to and debtor failure risk.

Credit constrained firms rely more extensively on trade credit for external financing in economic downturns according to recent empirical research (see, e.g., Garcia-Appendini and Montoriol-Garriga 2011; and Carbó-Valverde, Rodríguez-Fernández, and Udell 2012). Such a relationship suggests that the pool of trade debtors is of inferior quality when the economy slows down. Riskier debtors, in slowdowns, should then increase the likelihood that trade creditors experience a debtor failure. To explore this presumption we augment the model reported in Column (II) by Swedish real output growth, $\triangle GDP$, and again we include the growth variable both linearly and interacted with the accounts receivable variable. The linear term captures business cycle fluctuations in the aggregate bankruptcy risk (as measured by trade debtor failures) and the interaction term shows whether issuance volume is disproportionally related to the risk of experiencing a trade debtor failure in recessions. Column (III) shows that the coefficients are negative and significant for the variables related to output growth; -4.206 for the linear term and -3.822 for the interaction term. Thus, our finding of an enhanced relationship between trade credit issuance and trade debtor failure risk in economic downturns are in line with the predictions that trade creditors serve debtors that on average are of a lower credit quality during bust periods.

To take further account of firm characteristics that may influence creditors' propensity to issue trade credit, we estimate a model augmented by a set of important determinants as documented by, for example, Petersen and Rajan (1997) and Gianetti et al. (2011). Thus, we include profitability to control for the creditors' ability to generate internal funds, the age of the creditor for credit worthiness, and creditors' fixed assets for their asset tangibility. The results reported in Column (IV) show that the coefficients for accounts receivable, total assets, and output growth are essentially the same when these additional firm characteristics are included. The coefficients for profitability, firm age, and fixed assets are statistically significant. However, the estimated marginal effects suggest that their impact on creditor risk of facing trade debtor failure is economically insignificant.

It is likely that other characteristics matter for the likelihood that a creditor experiences a trade debtor failure. For example, some creditors, independent of size, provide goods or services to a large number of costumers due to the nature of their businesses, which will in itself increase the likelihood of experiencing a debtor failure. In addition, unobservable creditor characteristics may potentially impact on the creditors' risk taking by affecting their willingness to extend credit to debtors with low credit worthiness. In order to control for such unobservable characteristics that are persistent over time we estimate a linear probability version (OLS) of Equation (1), where we include firm-fixed effects. Column (V) reports coefficient estimates for the firm-fixed effects model. The obtained slope coefficient for the accounts receivable variable is positive and significant, 0.087. We can compare this coefficient with the average marginal effect of 0.179, obtained for the logistic version of the model (Column (I)). Thus, the impact drops slightly in magnitude once we control for firm-fixed effects. Nevertheless, the fixed-effects coefficient confirms that there is a strong impact of issuance volume on the risk of experiencing a trade debtor failure. Moreover, in Column (VI) we report results for a firm-fixed effects model where we include the variables related to firm size, output growth, and the additional firm characteristics. The obtained coefficients are in line with the results obtained from the logistic model; firm size exhibit a positive impact on the likelihood of experiencing a trade debtor failure and the relationship between issuance volume and debtor failure risk is enhanced in economic downturns.

Summing up, the results reported in Table 3 show that firms that issue more trade credit are more exposed to credit losses due to trade debtor failure. We also document that there is a strong relationship between firm size and the likelihood of experiencing a trade debtor failure, and that the impact of issuance volume on the debtor failure risk is enhanced in economic downturns. We will now proceed by exploring how issuance-volume, firm size, and business cycle fluctuations are related to the size of credit losses incurred by creditors when hit by trade debtor failures.

3.1.2 The size of the credit loss incurred by trade debtor failure

The next natural step is to examine if the size of the claims held on bankrupt trade debtors are related to the amount of accounts receivable that trade creditors issue. This is done by estimating a model where we regress the size of the bankruptcy claim — the natural logarithm of the bankruptcy claim held by creditor i at time t, scaled by the creditor's total assets at time $t-1$ — on the amount of trade credit issued by firm i in year $t-1$, and a vector of control variables, Z_i:

$$\log(Claims_{i,t}/assets_{i,t-1}) = \alpha + \delta \times accounts\ receivable/assets_{i,t-1} + \beta \times Z_{i,t-1} + \varepsilon_{i,t}. \quad (2)$$

Similar to Equation (1), the vector Z_i will include a set of firm-specific variables and a set of industry- and time-fixed effects to control for cross-industry heterogeneity and business cycle fluctuations in the size of the credit losses. In order to control for a potential selection bias, we also report results obtained from a Heckman estimation of Equation (2). The models are estimated for the period 1996 to 2010, which is the period for which we observe the size of the claims held by trade creditors on the bankrupt debtors.

[Insert Table 4 about here.]

Column (I) in Table 4 reports results from an industry- and time-fixed effects estimation of Equation (2). The slope coefficient is positive and significant, 1.691, indicating that firms that issue more trade credit on average have larger claims once a trade debtor fails. Based on the coefficient estimate we find that a one standard-deviation increase in accounts receivable is associated with a ($1.691 \times 0.185 =$) 31 percent larger claim. Hence, creditors that issue more trade credit experience, on average, a substantially larger credit loss conditional on a trade debtor failure.

We previously documented that large firms exhibit an enhanced likelihood of experiencing a trade debtor failure, which is presumably due to a positive relationship between firm size and the number of customers the firm serves. However, a firm that provides credit to a larger number of customers are more diversified and should therefore experience — in relation to its assets — smaller credit losses conditional on a trade debtor failure. We test this presumption by augmenting the model reported in Column (I) by the natural logarithm of creditors' total assets. Column (II) shows that the coefficient for the logarithm of total assets is negative and significant, -0.711, demonstrating that larger firms on average experience a smaller loss conditional on a trade debtor failure. The effect is both statistically and economically significant. Comparing two firms of which the larger one has 10 percent more assets, yields the mean prediction that it will experience a 7.1 percent smaller credit loss conditional on a trade debtor failure.

Next we examine whether the size of credit losses depend on the state of the business cycle by also including the real output growth, $\triangle GDP$. Column (III) shows that the coefficient for output growth is positive and significant, 1.016. However, the magnitude of the coefficient indicates that business cycle fluctuations do not have an economically significant effect on the trade credit losses. This result is consistent with the descriptive statistics reported in Table 1, showing that the average size of creditors' losses is quite stable over the sample period (Column (VI)).

The model reported in Column (III) is now augmented by a set of firm characteristics that the trade credit literature has identified as important determinants of firms propensity to issue trade credit. Column (IV) shows that profitability, age, and fixed assets have a statistically significant impact on the size of the bankruptcy claims. However, it is only the coefficient related to profitability, $EBIT/assets$, that yields an economic significant effect. More specifically, a one-standard-deviation higher profitability is associated with a $(-0.481 \times 0.214 =)$ 10 percent smaller credit loss conditional on a debtor failure. The coefficients for accounts receivable, firm size, and the business cycle remain quantitatively the same.

Finally, the reported results may suffer from a sample selection bias and for that purpose we estimate a sample selection model in two steps. The first-step considers an estimation of the likelihood of facing a trade debtor failure. In the second-step we make use of the first-step estimates to control for the presence of a selection bias. Our first-step model coincides with Model (IV) in Table 3. Column (V) reports the coefficient estimates obtained from the second-step model. In general, coefficients remain close to the OLS estimates. Importantly, the coefficients for the accounts receivable and firm size variables have the same sign and magnitude in the sample selection model. Thus, the results obtained from the selection model confirm that issuance-volume and firm size are important determinants of incurred credit losses due to trade debtor failures.

3.2 Creditor failure risk imposed by a trade debtor failure

We have so far documented that firms that issue trade credit are exposed to credit losses due to trade debtor failures. In this sub-section we will explore how the likelihood of trade creditor failure is related to trade debtor failure and the credit losses incurred due to these events. By doing this we quantify the importance of trade credit chains for the propagation of corporate failures. We also report a set of test where we evaluate how robust our results are to the impact of common shocks, to unobservable creditor characteristics, and to demand shocks. Finally, in order to better understand the nature of the shocks involved in trade credit losses, we explore a set of cross-sectional determinants of bankruptcy risk due to trade debtor failure.

3.2.1 Baseline results

We will now attempt to quantify firm failure risk conditional on trade debtor bankruptcy by means of a logistic model. For this purpose we consider the two indicator variables: $TCF_{i,t}$ and $TDF_{i,t}$. The dependent variable $TCF_{i,t}$ captures whether, or not, firm i (possibly, but not necessarily a trade creditor) fails in year t. $TDF_{i,t}$ is an indicator of whether, or not, firm i experienced a trade debtor failure in year t. The considered model, including a vector of control variables, Z_i, is then on the form:

$$P\left(TCF_{i,t}=1\right)=\frac{1}{1+\exp\left(-\left(\alpha+\eta\times TDF_{i,t}+\beta\times Z_{i,t-1}\right)\right)}. \tag{3}$$

We control for the firms' capital structure, cash and liquid asset holdings, profitability, size, and age. These are variables that are documented as important determinants of firm failure (see, e.g., Shumway 2001; Campbell, Hilscher, and Szilagya 2008; and Jacobson, Lindé, and Roszbach 2012). Moreover, we also include industry- and time-fixed effects to control for cross-industry heterogeneity and the impact of the business cycle on bankruptcy risk.

[Insert Table 5 about here.]

Column (I) in Table 5 reports results from an industry- and time-fixed effects regression. The coefficient for the variable indicating whether the firm experienced a trade debtor failure is positive and significant, 0.749. This shows that a credit loss imposed by a trade debtor failure has a positive impact on the likelihood that a trade creditor fails. When we include the firm-specific control variables in Column (II) then the coefficient on TDF increases to 0.906. The coefficients for the control variables are in line with the literature and intuitive. Liquidity to assets, profitability and firm size are negatively related to trade creditor bankruptcy, whereas leverage to assets has a positive relationship. Calculating the average marginal effect of facing a trade debtor bankruptcy shows that a trade creditor is associated with a (0.018/0.021=) 86 percent increased annual bankruptcy risk at the mean. Hence, these results indicate that trade debtor failure is an important risk factor for trade creditors.

It is reasonable to expect that the size of the claim held by a trade creditor on a failing trade debtor will be crucial for the impact. Using data for the sub-period 1996 to 2010, for which we have sizes of creditor claims, we examine their quantative importance. This is done by augmenting Equation (3) by three dummy variables that correspond to different regions of trade creditor's claims-to-assets. Thus, we consider smaller claims below 5 percent of assets, intermediate ones between 5 and 15 percent, and larger ones above 15 percent of assets. Slope coefficients for the three claim-size dummy variables are reported in Column (III). We find that trade creditor bankruptcy risk is enhanced in the size of the claims-to-assets variable. The average marginal effects document that annual bankruptcy risk increases by (0.009/0.021=) 43 percent for small claims, (0.028/0.021=) 133 percent for intermediate ones, and (0.041/0.021=) 195 percent for large ones, at the mean. These results indicate that the impact of a large credit loss implies a substantially enhanced failure risk for a trade creditor.

The results in Table 5 suggest that the credit losses invoked on trade credit issuing firms when their customers go bankrupt are indeed an important determinant of firm failure. The strong correlation between the size of the claim and the induced creditor failure risk make it conceivable that trade credit chains make up a channel in which firm failure propagate throughout the economy. Imagine small firms with a small range of customers, and in turn being supplied by small firms, and it is easy envision a domino effect arising as the credit loss progresses. In order to confirm that the bankruptcy risk that a trade debtor failure induces on its trade creditors is caused by the credit loss we proceed by evaluating a set of alternative explanations.

3.2.2 Common shocks and unobservable creditor characteristics

We will now undertake a series of checks to evaluate how robust the findings outlined above are to alternative explanations. In particular, we want to demonstrate that the shocks induced through trade credit issuance and subsequent trade debtor failures are related to the credit loss.

The first alternative explanation that we propose is that the increased creditor failure risk induced by a trade debtor failure is in fact a spurious correlation due to a common shock that simultaneously affects both the trade debtor and his creditors. To fix ideas, consider two firms

— a supplier and his customer — located in the same city and operating in the same industry. Suppose a shock, say a cost-push shock, simultaneously hit them and is severe enough to fail them both. Then the debtor failure may appear to cause the creditor failure when in fact the failure events are outcomes of the common shock. In order to control for such common shocks we estimate Equation (3) augmented by various combinations of interacting fixed effects with respect to time, industry, and location. For the industry-fixed effects we consider one- and two-digit SNI codes, and location is determined at the county level (Swedish län, 21 areas).

[Insert Table 6 about here.]

Column (I) in Table 6 reports results from an estimation of Equation (3) where we include the interaction between time- and industry-fixed effects (at the 1-digit SNI level). The obtained slope coefficient is positive and significant, 0.904, and is very close to the coefficient obtained in our baseline regression (Column (II) in Table 5). In Column (II) we report results from a model where we control for the location of the creditors by including an interaction term between the time- and location-fixed effects. The obtained coefficient is positive and significant, 0.905, and very close to that of the model where we only control for industry belonging. Finally, in Column (III) we report results for a model that includes a triple interaction between the time-, industry-, and location-fixed effects. The slope coefficient drops slightly in magnitude to 0.900, but is quite similar to the one obtained in our baseline regression.

The second alternative explanation that we attempt is the idea that a trade debtor failure is in fact a signal of poor creditor quality. More specifically, if creditors of poor credit quality extend credit to debtors of poor credit quality, then we would observe clusters of debtor failures over time for these creditors. If the poor quality creditors carry a significantly higher bankruptcy risk, then it would appear — in the cross-section — as if debtor failures cause creditor failures, whereas the creditor failures instead are outcomes of unobservable creditor characteristics. We test for this by estimating a linear probability model version of Equation (3) and by including firm-fixed effects in order to control for unobservable creditor characteristics that are persistent over time. Thus, the firm-fixed effects will control for a bias in the TDF coefficient that is caused by that trade debtor failures being clustered along the firm-years of creditors that subsequently fail. Moreover, we also include the triple interaction between the time-, industry-, and location-fixed effects to control for any potential impact of common shocks. Column (IV) shows that the obtained coefficient is positive and significant, 0.019. The magnitude of the coefficient implies that a trade debtor failure on average imposes a 1.9 percentage point higher annual bankruptcy risk on a trade creditor. The impact is close to identical to the average marginal effect of 1.8, which we obtained for our baseline regression (Column (II) in Table 5). Finally, we estimate a version of the firm-fixed effects model where we instead of one-digit industry codes make use of two-digit industry codes to further control for common shocks. In the interest of a manageable number of estimated coefficients, we specify double interactions rather than the triple interaction when using the two-digit SNI codes. Column (V) shows that the coefficient remains positive and significant, 0.018, which, again, is very similar to our baseline result.

In sum, the results reported in Table 6 suggest that our results are robust to the impact of common shocks and unobservable creditor characteristics.

3.2.3 Demand shocks

As shown above, a trade creditor incurs a credit loss when facing a trade debtor failure. However, another important aspect is that a trade debtor failure invariably involves elements of a demand shock on the trade creditors. The intuition for demand shocks is straight forward. Suppose that the trade debtor is an important customer whose purchases make up a sizable share of the suppliers annual sales, and further that the supplier's production is targeted to service this particular customer and cannot readily be adapted to alternative customers.[9] Suppose further that purchases are frequent, each small in size but over a year adding up. The shock induced by the customer's failure in this scenario is not so much about the pecuniary loss associated with the particular shipment that the customer defaulted on, but more so the loss of sales over time, i.e., a reduction in demand.

Our strategy to evaluate the relative importance of credit and demand shocks arising in trade debtor failures is to two-fold. Firstly, Hertzel et al. (2008) propose that firms producing specialized goods, as measured by $R\&D$ expenditures, are more exposed trade creditors. They argue that such firms are more dependent on long-term supplier-customer relationships. Hence, the debtor failure for creditors that produce specialized goods should be more severe in the demand-loss dimension. Exploring trade debtor failure's effects on trade creditors operating in $R\&D$ intense industries should therefore provide insights on the relative importance of the demand shocks. Secondly, one would expect the demand shock to be less important if a failed trade debtor is substantially smaller than its trade creditor. More specifically, the fraction of a creditor's total sales concerning a specific debtor should on average be proportional to the firms' relative sizes, i.e., a small fraction can be expected for a large creditor and a small debtor. For such cases, debtor failures should not lead to large declines in the demand for the creditors' goods and the increased risks should therefore mainly be driven by the credit losses. Thus, considering the relative sizes of the creditors and debtors per se should therefore offer additional insight on the nature of shocks imposed by trade debtor failures.

[Insert Table 7 about here.]

Based on the intuition that the demand shock is more severe for firms that produce specialized goods we will estimate a version of Equation (3) augmented by a dummy variable indicating whether, or not, the creditor operates in a $R\&D$ intense industry, $D(R\&D > 75)$. This dummy

[9] The supplier has committed to the customer by undertaking relationship-specific investments.

variable is constructed by first ranking all industries (at the 2-digit SNI level) in terms of $R\&D$ intensity. $R\&D$ intensity in a given industry is measured by the fraction of firms that have reported positive $R\&D$ expenditures in at least one financial statement in the sample period. We assign the value one to the $R\&D$ dummy if firm i belongs to an industry in the upper quartile of the $R\&D$ intensity industry distribution, and zero otherwise.[10] The sample is restricted to the period 1998 to 2008 due to data limitations on $R\&D$ expenditures. Column (I) in Table 7 shows that the TDF coefficient is positive and significant, 0.917, and of the same magnitude as the coefficient reported in our baseline regression (Column (II) in Table 5). The coefficient for the interaction term between the TDF variable and the $R\&D$ dummy is positive and significant, 0.240, indicating that firms that produce specialized goods on average are more vulnerable to trade debtor failures. The coefficient for the $R\&D$ dummy is small and insignificant, 0.019, indicating that belonging to a $R\&D$ intense industry is per se not associated with an increased failure risk.

To further explore the role of demand shocks we partition the TDF variable with respect to whether, or not, the creditor operates in a $R\&D$ intense industry in combination with whether, or not, the bankruptcy claim to (creditor) assets is below, or above, the 25^{th} percentile of the claim-to-assets distribution. The value of the 25^{th} percentile of the claims-to-assets distribution is around 0.1 percent, which indicates that the losses in the first quartile are fairly modest. Thus, a credit loss of such magnitude should entail a negligible reduction in the value of the creditor's assets and liquidity holdings. Nevertheless, even if the credit loss is small, the trade debtor failure may impose a demand shock on the creditor. Column (II) reports the coefficients for the four groups. The coefficient corresponding to small credit losses hitting firms that operate in industries with a medium and low $R\&D$ intensity is small yet boarderline significant (at the

[10] For the period 1998 to 2008, 8 percent of the firm-year observations have been assigned an $R\&D$ dummy equal to unity. The $R\&D$ intense industries are on average substantially smaller in comparison with other industries. This explains why the fraction of firms operating in these industries is less than 25 percent of the total number of firms-years in the sample.

10-percent level), 0.092. The average marginal effect indicates that a loss of this size imposes a (0.001/0.021 =) 5 percent higher yearly bankruptcy risk, at the mean, which is modest. This can be compared with the impact of small credit losses on firms that operate in $R\&D$ intense industries. The average marginal effect for this group yields a (0.006/0.021 =) 29 percent increased yearly bankruptcy risk, at the mean, which is not negligible. The coefficients for the two groups are statistically different (at the 10-percent level). For large claims, we see that the difference between the two groups persists where the average marginal effects is 0.4 percentage points higher for firms operating in $R\&D$ intense industries (the difference is significant at the 1-percent level). Thus, this exercise suggests that demand shocks do play a role in explaining portions of the increased creditor risk due to debtor failure.

Moreover, based on the sub-period 2007 to 2010 for which we observe the identity of the trade debtor, we estimate yet another version of Equation (3) where we have split the TDF variable into three sub-variables. The TDF variable is grouped with respect to the relative sizes of the trade creditors and the failed trade debtors. The first sub-variable corresponds to cases where total assets of the debtor are less than 10 percent of total assets of the creditor, $TDF(assets^{TD}/assets^{TC} < .10)$, and the second sub-variable corresponds to cases where total assets of the debtor are larger than or equal to 10 percent of total assets of the creditor, $TDF(assets^{TD}/assets^{TC} \geq .10)$. We also include a control variable that corresponds to trade debtor failures for which we do not observe any accounting information for the debtor, $TDF(No\ acc.\ Info.)$. The main intuition for this specification is that demand shocks should be very small for cases where the trade debtor is substantially smaller than the trade creditor. Column (III) shows the coefficient estimates for the three TDF sub-variables. The coefficient estimate for the cases where the debtor is small as compared to the creditor is positive and significant, 0.734, confirming that the event imposes an increased bankruptcy risk on the creditor. The average marginal effect shows that the yearly bankruptcy risk is enhanced by (0.010/0.021 =) 48 percent, at the mean. For cases where the assets of the debtor are larger than or equal to 10 percent of the creditor's assets, we obtain a positive and significant coefficient, 0.950, which is very close to the coefficient obtained in our baseline regressions (Column (II) in Table 5). The coefficient estimates for the two variables are statistically different (at the 5-percent level). Thus, these results show that a trade debtor failure introduces a substantially enhanced bankruptcy risk on its trade creditors, even if the debtor failure imposes only a marginal decline in the demand for the creditors' goods or services.[11]

Summing up, the results reported in Table 7 suggest that the demand shock to some extent enhance the bankruptcy risks that trade debtor failures impose on trade creditors. Nevertheless, the regression where we control for the relative sizes of the trade creditors and debtors indicates that it is mainly credit losses that cause increased creditor failure risks.

3.2.4 Cross-sectional determinants of the creditor failure risk imposed by a trade debtor failure

We will now attempt to further deepen our understanding of the propagation process in corporate failure by evaluating a set of factors that the credit chain literature has identified as important determinants in this context. In particular, we will take the trade debtor failure variable, TDF, and interact it with the various propagation factors — one at a time, as well as jointly — in order to determine cross-sectional variation in the creditor failure risk. Table 8 reports results obtained when augmenting Equation (3) by interactions between TDF and the propagation factors. Our specifications also include the considered propagation factors linearly, as well as the set of firm-specific controls, Z_i, used in Models (II) and (III) in Table 5.

[11] The difference between the two groups is likely to be affected by the fact that credit losses on average are smaller for cases where the debtor is substantially smaller than the creditor. Descriptive statistics show that the average claim-to-assets is 1.9 percent for cases where the assets of the debtor is less than 10 percent of the assets of the creditor, and 2.5 percent when the assets of the debtor is larger or equal to 10 percent of the assets of the creditor. Nevertheless, the main purpose of the exercise is to show that a trade debtor failure imposes a substantially enhanced bankruptcy risk on its creditors, even when the debtor failure is expected to have a negligible demand effects.

[Insert Table 8 about here.]

The first factor that we consider is a fundamental one: corporate capital structure. The credit losses due to a trade debtor failure imply that the value of the creditors' assets is reduced. A sufficiently large credit loss may therefore push a creditor into balance-sheet-based insolvency. The risk that a trade debtor failure will push a creditor into financial distress is therefore dependent on the creditor's indebtedness. More leveraged creditors should thus be more vulnerable to the credit losses in a trade debtor failure. Along these lines, Hertzel et al. (2008) propose the hypothesis that highly leveraged firms, due to less financial flexibility, are more exposed to trade debtor failures. That is, highly leveraged firms may be constrained in the amount of additional external financing that they can raise in order to offset the incurred credit loss. Column (I) in Table 8 reports the coefficient for the interaction term between TDF and firms' leverage ratios. The estimated slope coefficient is positive and significant, 0.545, confirming that trade creditors with higher leverage levels are indeed more vulnerable to trade debtor failures.

The second factor that we explore is corporate cash holdings. Kiyotaki and Moore (1997) argue that the propagation of corporate failure is mitigated if the trade creditors are cash rich. More specifically, the credit loss that a trade debtor failure imposes on its creditors implies a shock to the creditors' liquidity holdings. If the credit loss is large enough, then it may push the creditor into cash-flow-based insolvency. We test this hypothesis by augmenting the model with an interaction term between TDF and trade creditors' cash and liquid assets holdings. Column (II) shows that the resulting coefficient for this interaction term is negative and significant, -1.716, implying that the propagation effect is mitigated if the trade creditor has larger liquidity holdings. Moreover, following the same intuition we will examine whether trade creditors that are more profitable prior to facing a trade debtor failure are less likely to fail themselves. Column (III) reports a negative and significant coefficient, -0.366, for the interaction term between TDF and firms' profitability. Thus, more profitable firms are less vulnerable when facing a failing trade debtor, a result in support of the hypothesis that firm profitability matters for propagation.

An interesting question is whether trade creditors' vulnerability to trade debtor failure depends on the state of the business cycle. Access to external financing is potentially reduced during economic downturns, c.f., Bernanke and Gertler (1989), which reduces trade creditors' opportunity to offset the credit loss by raising external finance. We test this hypothesis by including an interaction term between TDF and real output growth, $\triangle GDP$. The time-fixed effects included in the model control for the aggregate shocks imposed by business cycle fluctuations. Column (IV) shows that the resulting coefficient is negative and significant, -4.194, indicating that the failure risk imposed by a trade debtor failure is enhanced during economic downturns. Of course, although the external financing argument is likely to hold, one must also acknowledge demand effects. Recessions involve reductions in general demand, in this context we should also consider pronounced demand effects from trade debtor failures.

Finally, Column (V) shows that the results above continue to hold when we include all interaction terms simultaneously. The coefficients in Column (V) are remarkably similar to the regressions where the propagation factors are entered seperately. Thus, in sum, our results show that the propagation mechanism is alleviated for firms that are less levered, cash rich, highly profitable, and enhanced in economic downturns.

4 Concluding Remarks

Theoretical research proposes that the inter-firm linkages induced by trade credit propagate corporate failures. In this paper, we utilize an extensive Swedish data set where we observe whether firms, in their role as trade creditors, experienced a trade debtor failure. This data set provides a unique opportunity to explore how credit losses invoked by a trade debtor failure impacts the likelihood that the trade creditor, in turn, fails. Our results show that firms that issue more trade credit are more exposed to trade debtor failures, both in terms of the likelihood of experiencing a debtor failure and the loss given failure. We also document that a trade debtor failure imposes a substantially enhanced bankruptcy risk on its trade creditors, and that the increased risk mainly is caused by the credit loss hitting them. Exploring cross-sectional heterogeneity in the bankruptcy risk imposed by a trade debtor failure, we find that trade creditors that produce standardized goods, are less levered, cash rich, highly profitable, and operate during economic upturns are less vulnerable to trade debtor failures. These results show that the credit chains induced by trade credit are important for the propagation of corporate failures.

On the aggregate level, we show that the credit losses incurred by Swedish trade creditors amount to twice or more than those of Swedish banks on loans to non-financial firms. To the extent that we worry about real effects arising from bank credit losses, we should also — on the grounds of the results documented in this paper — worry about trade credit losses. Given that firms may carry substantial financial assets and liabilities on their balance sheets in the form of accounts payable and receivable, they are in effect performing the task of financial intermediation. However, they are financial intermediaries for which no bank regulation applies, no capital buffer requirements are in place, or any supervision is carried out. In addition, one can also take into consideration a legal framework that, in most countries, offer little support for weak players, i.e., small suppliers at the mercy of large and few customers. This begs the question if not substantial efficiency gains could be reaped by enhancing policy efforts in this area.

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Table 1: Descriptive statistics; trade credit, bankruptcy rates, trade debtor failures, and credit losses

This table provides descriptive statistics on: the average amount of accounts receivable to total assets (Accounts receivable to total assets); the fraction of yearly bankruptcies (Bankruptcy frequency); the fraction of firms that experience one, or more, trade debtor bankruptcies in a given year (Trade debtor bankruptcy frequency); total amount of unsecured junior claims held on bankrupt trade debtors, in million SEK (Unsecured junior claims); Swedish banks' total credit losses to non-financial firms (Banks' credit losses non-financial firms) (Source: Statistics Sweden, Financial Markets Statistics); the size of the claims that the trade creditor has on bankrupt trade debtors in relation to creditor's total assets (Bankruptcy claims-to-assets); the percentage of bankruptcies where we observe that the bankrupt firm experienced a failure on one, or more, of its trade debtor claims in the bankruptcy year (Share of bankruptcies involving trade debtor bankruptcies); and the size of the claims that the trade creditor has on the failed trade debtor to total assets for bankrupt trade creditors (Bankruptcy claims-to-assets in creditor bankruptcy).

Year	(I) Accounts recievable to assets	(II) Bankruptcy frequency	(III) Trade debtor bankruptcy frequency	(IV) Unsecured junior claims (M SEK)	(V) Banks' credit losses non-financial firms (M SEK)	(VI) Bankruptcy claims–to–assets	(VII) Share of bancrupties involving trade debtor bankruptcy	(VIII) Bankruptcy claims–to–assets in creditor bankruptcy
1992	0.175	0.052	0.151	–	–	–	0.326	–
1993	0.170	0.049	0.173	–	–	–	0.333	–
1994	0.176	0.032	0.110	–	–	–	0.212	–
1995	0.183	0.024	0.084	–	–	–	0.165	–
1996	0.181	0.024	0.108	1 959	–	0.024	0.158	0.088
1997	0.175	0.024	0.098	1 761	–	0.024	0.133	0.082
1998	0.172	0.020	0.088	1 845	–	0.022	0.140	0.097
1999	0.169	0.016	0.086	1 818	–	0.021	0.153	0.083
2000	0.168	0.016	0.081	1 682	–	0.021	0.131	0.103
2001	0.166	0.017	0.085	3 031	–	0.024	0.174	0.109
2002	0.166	0.019	0.087	3 183	–	0.024	0.179	0.102
2003	0.163	0.019	0.085	3 031	–	0.024	0.168	0.093
2004	0.160	0.017	0.079	2 962	1 066	0.023	0.152	0.106
2005	0.162	0.014	0.059	1 728	1 185	0.020	0.118	0.095
2006	0.163	0.013	0.053	1 468	1 073	0.020	0.098	0.123
2007	0.166	0.012	0.046	1 413	771	0.019	0.088	0.091
2008	0.165	0.014	0.058	2 052	954	0.020	0.106	0.094
2009	0.156	0.018	0.068	3 005	1 959	0.022	0.130	0.089
2010	0.154	0.015	0.055	2 246	1 706	0.020	0.094	0.102
Average	0.168	0.021	0.085	2 212	1 245	0.022	0.186	0.097

Table 2: Descriptive statistics for firm-specific variables

The table reports descriptive statistics for a set of firm-specific variables for the period 1992-2010, grouped on all firm-years, firm-years where the firm experienced one or more of trade debtor failures (Trade debtor failure) in year t, and firm years where the firm did not experience any trade debtor failures (Non trade debtor-failure) in year t. All firm-specific variables correspond to year $t-1$. '*Assets*' is total assets of the firm, deflated by means of consumer prices, with year 2000 prices as base. '*EBIT*' is earnings before interest and taxes. '*Firm age*' is the number of years since first registrated as a corporate. '*Fixed assets*' corresponds to property, plants and equipment. Trade creditor claims on failed trade debtors are calculated for firm-years with trade debtor failures, during the period 1996 to 2010. The star (*) reported next to the mean and median values for the 'Non trade debtor failure' group denote that these values are statistically different from the 'Trade debtor failure' group's means and medians at the 1 percent level. Differences in means are assessed using a Student's t-test. Differences in medians are assessed using the Wilcoxon-Mann-Whitney test for continues variables and the Pearson's Chi-square test for categorical variables.

		All firms			Trade debtor failure		Non trade debtor failure			
Variables	Truncation	Mean	Median	Std	Mean	Median	Mean		Median	
Accounts recievable/assets	$[0, 99\%]$	0.168	0.106	0.185	0.259	0.233	0.159	*	0.093	*
Accounts payable/assets	$[0, 99\%]$	0.126	0.069	0.157	0.173	0.128	0.122	*	0.064	*
Assets (in SEK 1,000)	SEK $100,000 \leq$	23 434	1 432	631 670	111 711	5 624	15 233	*	1 298	*
Total liabilities/assets	$[0, 99\%]$	0.652	0.666	0.314	0.703	0.730	0.648	*	0.659	*
Cash and liquidity/assets	$[0, 99\%]$	0.218	0.120	0.243	0.131	0.051	0.226	*	0.129	*
EBIT/assets	$[1, 99\%]$	0.062	0.064	0.214	0.060	0.066	0.062	*	0.063	
Firm age		13.724	10.000	13.592	18.650	13.000	13.267	*	9.000	*
Fixed assets/assets	$[0, 99\%]$	0.328	0.229	0.302	0.287	0.202	0.332	*	0.232	*
Bankruptcy (1/0)		0.021	0.000	0.144	0.046	0.000	0.019	*	0.000	
Bankruptcy claims/assets	$[0, 99\%]$				0.022	0.004				
Bankruptcy claims/recievable	$[0, 99\%]$				0.376	0.023				
Number of observations			3 576 758		304 012				3 272 746	

Table 3: Estimating the probability of facing a trade debtor failure

The table reports coefficient estimates from logistic and OLS regressions estimating the likelihood that a firm experience one or more trade debtor bankruptcies in year t, during the period 1992 to 2010. The dependent variable, TDF, indicates whether or not a firm experienced one, or more, trade debtor bankruptcies in year t. All firm-specific and the macroeconomic variable correspond to year $t-1$. $\triangle GDP$ is real output growth. The firm-specific variables are described in Table 2. dy/dx is average marginal effects. The pseudo-R^2 is calculated according to McFadden (1974). t-values that are calculated on robust standard errors, clustered on the firm level, are reported within parenthesis.

	Dependent variable: TDF (0/1)									
	(I)		(II)		(III)		(IV)		(V)	(VI)
Variables:	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx	Coef.	Coef.
Accounts recievable/assets	2.433	0.179	-0.706	-0.046	0.062	0.004	0.176	0.012	0.087	-0.597
	(162.5)		(-4.0)		(0.4)		(1.0)		(56.1)	(-35.2)
Log($assets$)			0.524	0.034	0.499	0.033	0.491	0.033		0.023
			(150.9)		(147.8)		(141.3)			(63.2)
Accounts recievable/assets			0.238	0.016	0.189	0.013	0.184	0.012		0.050
× Log($assets$)			(19.6)		(16.0)		(15.4)			(39.5)
$\triangle GDP$					-4.206	-0.282	-4.204	-0.281		-0.180
					(-45.1)		(-45.0)			(-29.3)
Accounts recievable/assets					-3.822	-0.256	-3.859	-0.258		-0.885
× $\triangle GDP$					(-12.3)		(-12.5)			(-26.3)
Firm controls:										
$EBIT/assets$							-0.403	-0.027		-0.023
							(-29.1)			(-30.4)
Log($1+age$)							0.196	0.013		0.050
							(17.6)			(72.7)
Log$(1+age)^2$							-0.025	-0.002		-0.024
							(-8.7)			(-101.0)
Fixed assets/assets							-0.027	-0.002		-0.015
							(-1.9)			(-15.1)
Year-fixed effects	Yes		Yes		No		No		Yes	No
Industry-fixed effects	Yes		Yes		Yes		Yes		Yes	Yes
Firm-fixed effects	No		No		No		No		Yes	Yes
Model	Logistic		Logistic		Logistic		Logistic		OLS	OLS
Pseudo-R^2/R^2	0.078		0.192		0.168		0.169		0.387	0.389
Number of observations					3 576 758					

Table 4: Estimating the size of the claims held on failed trade debtors

The table reports coefficient estimates from OLS and Heckman regressions where the size of the claims that the trade creditor has on bankrupt trade debtors at time t is related to a set of firm-specific, macroeconomic, and industry control variables for the period 1996 to 2010. The dependent variable is the natural logarithm of the size of the claim that the trade creditor has on the bankrupt trade debtor at time t to total (creditor) assets at time $t-1$. If a trade creditor experiences multiple debtor failures in a year then we construct the dependent variable based on the sum of the claims. The first stage regression for the Heckman model includes the variable set that is included in Model (IV) in Table 3. The firm-specific and the macroeconomic variable correspond to year $t-1$. $\triangle GDP$ is real output growth. The firm-specific variables are described in Table 2. t-values, calculated on robust standard errors, are reported within parenthesis.

	Dependent variable: Log(*Claims/assets*)				
Variables:	(I)	(II)	(III)	(IV)	(V)
Accounts recievable/assets	1.691	0.702	0.702	0.642	1.070
	(43.4)	(30.5)	(30.5)	(25.6)	(39.1)
Log(*assets*)		-0.711	-0.711	-0.697	-0.636
		(-194.3)	(-194.3)	(-185.4)	(-151.1)
$\triangle GDP$			1.016	1.139	0.210
			(6.0)	(6.7)	(1.7)
Firm controls:					
EBIT/assets				-0.482	-0.521
				(23.8)	(-32.0)
$\text{Log}(1 + age)$				-0.128	-0.105
				(-8.4)	(-9.7)
$\text{Log}(1 + age)^2$				0.016	0.012
				(4.4)	(5.5)
Fixed assets/assets				-0.102	-0.098
				(-5.2)	(-7.2)
Heckman's lambda:					
λ					0.321
					(19.0)
Year-fixed effects	Yes	Yes	No	No	No
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes
Model	OLS	OLS	OLS	OLS	Heckman
R^2	0.111	0.551	0.551	0.554	
χ^2					107 798
Number of observations			2 903 734		

Table 5: Estimating the trade creditor bankruptcy risk imposed by a trade debtor failure

The table reports coefficient estimates from industry- and time-fixed effects logistic regressions estimating the likelihood that a firm fails as an outcome of facing a trade debtor bankruptcy. The estimation period is 1992 to 2010. The dependent variable, TCF, indicates whether a firm is bankrupt or not in year t. TDF is an indicator variable taking the value one if a firm experienced a trade debtor bankruptcy and zero otherwise, in year t. Bankruptcy claims to assets is the time t size of the claims the firm has on a bankrupt trade debtor to total (creditor) assets at time $t-1$, reported for the period 1996 - 2010. All firm-specific variables correspond to year $t-1$. The firm-specific variables are described in Table 2. dy/dx is average marginal effects. The pseudo-R^2 is calculated according to McFadden (1974). t-values calculated on robust standard errors, clustered on the firm level, are reported within parenthesis.

	Dependent variable: TCF (0/1)					
	(I)		(II)		(III)	
Variables:	Coef.	dy/dx	Coef.	dy/dx	Coef.	dy/dx
TDF (0/1)	0.749	0.015	0.906	0.018		
	(72.1)		(82.3)			
TDF(Claims/assets < .05) (0/1)					0.584	0.009
					(33.9)	
TDF(.05 ≤ Claims/assets ≤ .15) (0/1)					1.762	0.028
					(35.6)	
TDF(.15 < Claims/assets) (0/1)					2.567	0.041
					(69.2)	
Firm controls:						
Total liabilities/assets			1.553	0.030	1.473	0.024
			(135.0)		(110.8)	
Cash and liquid assets/assets			-2.558	-0.050	-2.569	-0.041
			(-74.4)		(-66.0)	
EBIT/assets			-0.886	-0.017	-0.853	-0.014
			(-55.1)		(-45.6)	
Log($assets$)			-0.134	-0.003	-0.192	-0.003
			(-43.2)		(-48.6)	
Log($1+age$)			1.160	0.023	1.111	0.018
			(78.1)		(60.5)	
Log$(1+age)^2$			-0.323	-0.006	-0.339	-0.005
			(-78.5)		(-63.1)	
Year-fixed effects	Yes		Yes		Yes	
Industry-fixed effects	Yes		Yes		Yes	
Pseudo-R^2	0.035		0.137		0.137	
Number of observations	3 576 758		3 576 758		2 903 734	

Table 6: Controlling for common shocks and unobservable creditor characteristics

The table reports coefficient estimates from logistic and OLS regressions estimating the likelihood that a firm bankrupts as an outcome of a trade debtor bankruptcy, during the period 1992 to 2010. The dependent variable, TCF, indicates whether a firm is bankrupt or not in year t. TDF is an indicator variable taking the value one if the trade creditor experiences a trade debtor failure and zero otherwise in year t. The industry fixed-effects are constructed based on one- and two-digit SNI codes, and the location fixed-effects are constructed according to a county level (Swedish län). All models are augmented with the firm-specific explanatory variables included in Model (II) to (IV) in Table 5. The pseudo-R^2 is calculated according to McFadden (1974). t-values for the logistic regressions are calculated with standard errors obtained after a sample size adjustment where the covariance matrix is scaled by the average number of firm-years per firm, so as to account for within firm dependence, c.f., Shumway (2001).

	Dependent variable: TCF (0/1)				
Variable:	(I)	(II)	(III)	(IV)	(V)
TDF (0/1)	0.904	0.905	0.900	0.019	0.018
	(29.6)	(29.6)	(29.5)	(67.7)	(67.4)
Specification:					
Year × Industry-fixed effect	Yes	Yes	No	No	Yes
Year × Location-fixed effect	No	Yes	No	No	Yes
Year × Industry × Location-fixed effect	No	No	Yes	Yes	No
Firm-fixed effect	No	No	No	Yes	Yes
Model	Logistic	Logistic	Logistic	OLS	OLS
SIC level	1-digit	1-digit	1-digit	1-digit	2-digit
Firm controls	Yes	Yes	Yes	Yes	Yes
Pseudo-R^2/R^2	0.139	0.140	0.142	0.470	0.486
Number of observations			3 576 758		

Table 7: Controlling for demand shocks

The table reports results from industry- and time-fixed effects logistic regressions estimating the likelihood that a firm fails as an outcome of facing a trade debtor bankruptcy. The estimation period is 1998 to 2010, and 2007 to 2010. The dependent variable, TCF, indicates whether a firm fails, or not, in year t. TDF is an indicator variable taking the value one if the firm experiences a trade debtor failure, and zero otherwise, in year t. '$D(R\&D \geq 75perc.)$' is a dummy variable that takes the value one if the trade creditor belongs to any of the 25 percent of the industries (two-digit SIC level) with the largest fraction of firms that report $R\&D$ expenditures, and zero otherwise. The four variables included in Column (II) correspond to a partitioning of the TDF variable with respect to whether the creditor belongs to any of the 25 percent of the industries (two-digit SIC level) with the largest fraction of firms that report $R\&D$ expenditures and whether the size of the bankruptcy claims to (creditor) assets is below or above the 25^{th} percentile of bankruptcy claims. The regressions where $R\&D$ is included is estimated for the sub-period 1998 to 2010 due to data limitations on $R\&D$ expenditures. The three variables included in Column (III) corresponds to a partitioning of the TDF variable with respect to whether total assets of the trade debtor is smaller or larger than one tenth of total assets of the trade creditor. We also include a control variable, '$TDF(No\ acc.\ Info.)$', which takes the value one for trade debtor failures where we do not observe any accounting information for the trade debtor, and zero otherwise. The regression where we control for debtor characteristics is estimated for the sub-period 2007 to 2010 for which we observe the identity of the trade debtor. All models are augmented with the firm-specific explanatory variables included in Model (II) to (IV) in Table 5. The pseudo-R^2 is calculated according to McFadden (1974). t-values calculated on robust standard errors, clustered at the firm level, are reported within parenthesis.

	Dependent variable: *TCF* (0/1)							
	(I)		(II)			(III)		
Variables:	Coef.	*dy/dx*	Coef.	*dy/dx*	*p-value*	Coef.	*dy/dx*	*p-value*
TDF (0/1)	0.917	0.014						
	(53.5)							
TDF (0/1) × *D(R&D ≥ 75 perc.)* (0/1)	0.240	0.004						
	(4.6)							
$TDF(R\&D < 75\ perc. \cap Claims/assets < 25\ perc.)$ (0/1)			0.092	0.001				
			(1.7)					
$TDF(R\&D \geq 75\ perc. \cap Claims/assets < 25\ perc.)$ (0/1)			0.368	0.006	0.071			
			(2.6)					
$TDF(R\&D < 75\ perc. \cap Claims/assets \geq 25\ perc.)$ (0/1)			1.011	0.015				
			(58.0)					
$TDF(R\&D \geq 75\ perc. \cap Claims/assets \geq 25\ perc.)$ (0/1)			1.262	0.019	0.000			
			(24.4)					
$D(R\&D \geq 75\ perc.)$ (0/1)	0.019	0.000	0.017	0.000				
	(0.8)		(0.7)					
$TDF(assets^{TD}/assets^{TC} < .10)$ (0/1)						0.734	0.010	
						(7.0)		
$TDF(assets^{TD}/assets^{TC} \geq .10)$ (0/1)						0.950	0.013	0.046
						(25.4)		
TDF(No acc. info.) (0/1)						0.927	0.013	
						(14.3)		
Year-fixed effects	Yes		Yes			Yes		
Industry-fixed effects	Yes		Yes			Yes		
Firm controls	Yes		Yes			Yes		
Sample period	1998-2010		1998-2010			2007-2010		
Pseudo-R^2	0.134		0.135			0.135		
Number of observations			2 537 104					

Table 8: Cross-sectional determinants of trade creditor bankruptcy risk imposed by a trade debtor failure

The table reports results from industry- and time-fixed effects logistic regressions estimating the likelihood that a firm fails as an outcome of facing a trade debtor bankruptcy. The estimation period is 1992 to 2010. The dependent variable, TCF, indicates whether a firm fails, or not, in year t. TDF is an indicator variable taking the value one if the firm experiences a trade debtor failure, and zero otherwise, in year t. The firm-specific and macroeconomic variables correspond to year $t-1$. $\triangle GDP$ is real output growth. The firm-specific variables are described in Table 2. The pseudo-R^2 is calculated according to McFadden (1974). t-values calculated on robust standard errors, clustered at the firm level, are reported within parenthesis.

	Dependent variable: TCF (0/1)				
Variables:	(I)	(II)	(III)	(IV)	(V)
TDF (0/1)	0.419	1.022	0.898	0.949	0.665
	(13.8)	(74.4)	(81.3)	(81.3)	(17.8)
TDF (0/1) × *Total liabilities/assets*	0.545				0.425
	(16.4)				(11.1)
TDF (0/1) × *Cash and liquid assets/assets*		-1.716			-1.461
		(-13.2)			(-11.0)
TDF (0/1) × *EBIT/assets*			-0.366		-0.105
			(-8.4)		(-2.0)
TDF (0/1) × $\triangle GDP$				-4.194	-3.933
				(-11.0)	(-10.1)
Firm controls:					
Total liabilities/assets	1.499	1.554	1.554	1.553	1.513
	(127.1)	(135.1)	(134.9)	(135.0)	(127.3)
Cash and liquid assets/assets	-2.560	-2.398	-2.559	-2.559	-2.428
	(-74.5)	(-68.5)	(-74.4)	(-74.4)	(-69.0)
EBIT/assets	-0.885	-0.885	-0.843	-0.885	-0.873
	(-54.6)	(-55.1)	(-50.2)	(-55.1)	(-51.5)
Log(*assets*)	-0.133	-0.135	-0.134	-0.134	-0.134
	(-42.6)	(-43.5)	(-43.1)	(-43.1)	(-42.8)
$\text{Log}(1+age)$	1.160	1.161	1.160	1.159	1.159
	(77.9)	(78.1)	(78.0)	(78.0)	(77.8)
$\text{Log}(1+age)^2$	-0.323	-0.324	-0.323	-0.323	-0.323
	(-78.2)	(-78.6)	(-78.4)	(-78.5)	(-78.2)
Year-fixed effects	Yes	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes
Pseudo-R^2	0.137	0.137	0.137	0.137	0.138
Number of observations			3 576 758		

Figure 1: Yearly Swedish overall bankruptcy frequencies and trade debtor failure frequencies

The solid line marks the yearly rate of overall Swedish corporate bankruptcies (left-hand scale), and the dashed line marks the fraction of corporate firms in Sweden that experienced one, or more, trade debtor bankruptcy(ies) in a given year (right-hand scale).

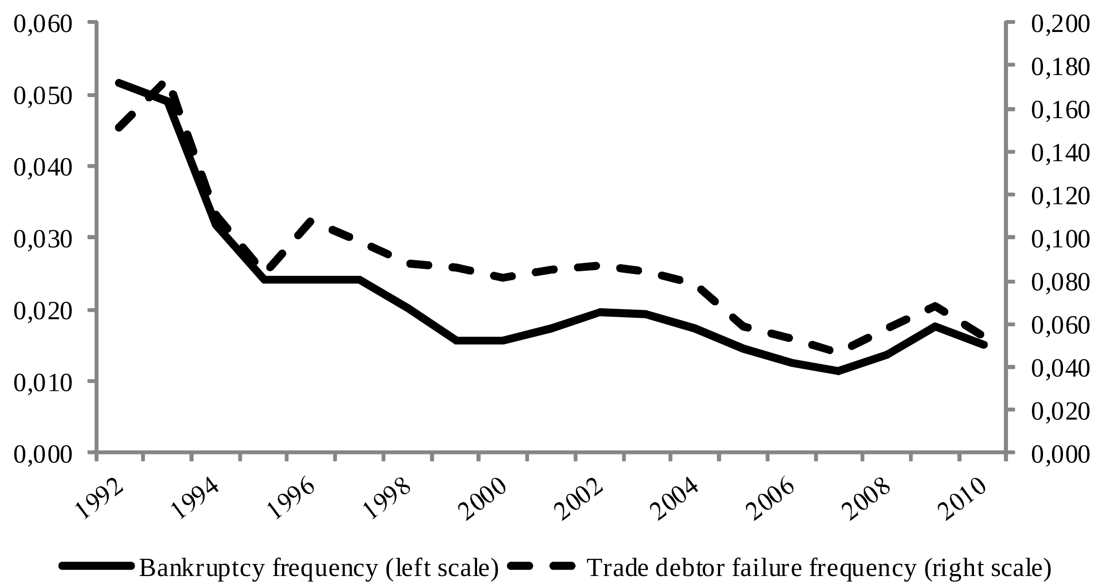
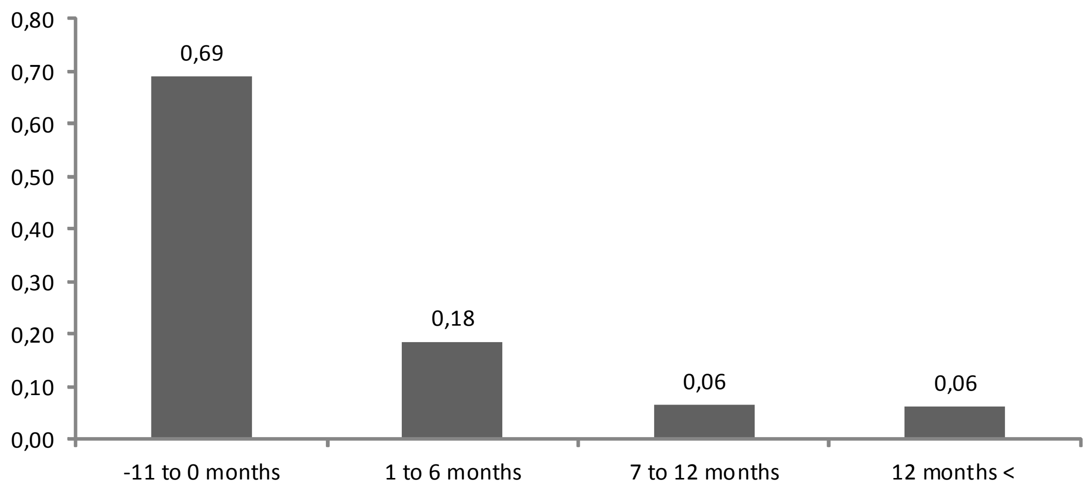


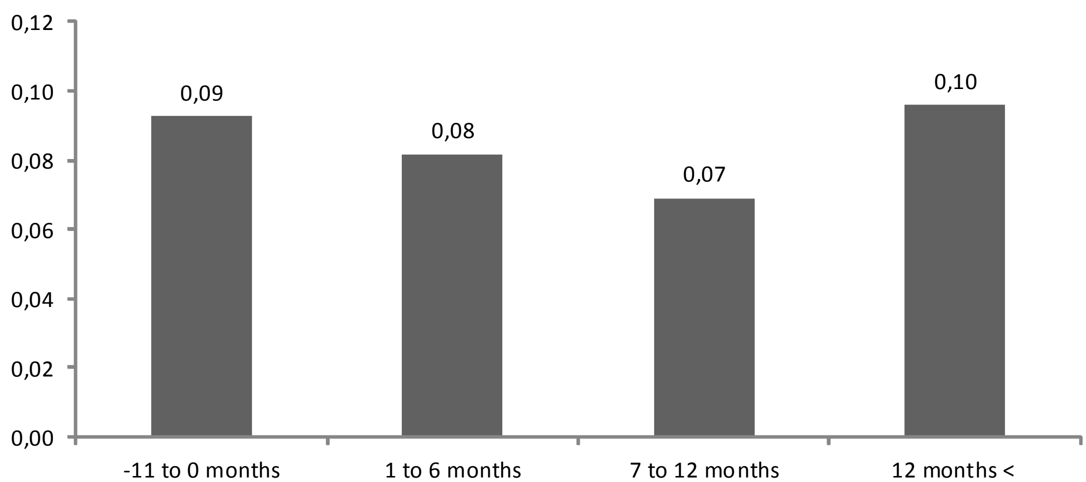
Figure 2: Failure timing and the size of the bankruptcy claims

Panel A provides a graphical illustration of the timing of trade creditor and debtor failures, for the sample period 2007 to 2010 for which we observe the debtor identities. We construct the graph based on the sample of bankrupt trade creditors that experienced at least one trade debtor failure in the eleven months preceding or at any point in time after their bankruptcy event. For cases where the creditor experienced multiple debtor failures we keep the debtor failure corresponding to the largest bankruptcy claim. The first staple corresponds to the fraction of trade debtor failures that took place in the eleven months preceding or in the same month as the trade creditor failure (-11 to 0 months). The second, third, and fourth stable correspond to the fraction of trade debtor failures that took place in one to six months (1 to 6 months), seven to twelve months (7 to 12 months), and more than twelve months (12 months $<$) after the creditor failure event, respectively. Panel B provides a graphical illustration of the average size of bankruptcy claims to total (creditor) assets.

PanelA: Creditor-debtor failure timing



Panel B: Claim-to-assets



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