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TRADE CREDIT AND FINANCIAL DESTRESS

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Trade credit and financial distress

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Abstract

Using a sample of firms matched with their suppliers, we study the evolution of the suppliers' provision of trade credit to distressed firms as they approach a default event. We show that, in the extensive margin, suppliers withdraw their financial support from distressed relationships, and they provide less financial support than banks, consistently with stronger incentives of uncollateralized, junior suppliers to exit from distressed relationships. However, we find a positive effect on the intensive margin as those firms with suppliers that continue the relationship increase their accounts payable. Finally, we show that suppliers of differentiated goods, suppliers located close to their distressed clients, suppliers that sell large proportions to the distressed clients, and suppliers selling to clients in a concentrated market are more likely to be held up in a distressed relationship.

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1. Introduction

The single largest exposures to the bankruptcy of an industrial firm take the form of trade credit, i.e., the credit offered by suppliers in exchange for an anticipated delivery of inputs (Jorion and Zhang, 2009; Evans and Koch, 2007). Theoretically, this finding has been usually justified with models that claim that suppliers have an implicit stake in their clients' business. According to these models, suppliers have strong incentives to provide trade credit to clients in financial distress to avoid losing a valuable client and in this way maintain their future earnings (Wilner, 2000; Cuñat, 2007). However, this argument is difficult to reconcile with the absence of contractual seniority and formal collateral that characterizes trade credit contracts, which exacerbate the potential losses of the supplier in case of a bankruptcy.[1] Consistently with this latter view, some studies argue that suppliers lose confidence progressively and withdraw their support to distressed clients (Baxter, 1967; Titman, 1984); Andrade and Kaplan (1998) provide some supportive evidence.

In this paper we shed some light on this apparent puzzle by examining whether firms in financial distress are likely to receive financial support from their suppliers. Our analysis begins by documenting the evolution of the use of trade credit by firms facing financial distress. Results show that on average, firms in an early distress stage increase their use of trade credit. However, as they become closer to the default event, firms rely less on trade credit, and more on other sources of short-term credit (such as contractually pre-committed bank lines of credit) as sources of external financing. We find that this lower dependence on trade credit is consistent with suppliers withdrawing their support to distressed firms, rather than on a lower demand for external financing.

Using a sample of firms matched with their suppliers, we are able to analyze the provision of trade credit in the extensive and the intensive margin. In the extensive margin, we find that the number of suppliers of distressed clients decreases well ahead of default. However, a sizeable number of suppliers continue the relationship with the distressed firm until the default event or shortly before the event. In the intensive margin, those suppliers that continue in the

[1] Some theories of trade credit claim that one advantage of suppliers is that the good they supply can serve as collateral (Frank and Maksimovic, 2005; Fabbri and Menichini, 2010). However, in the US (which is the economy that we study in this paper, and that is analyzed in the above cited papers) the legal period over which a supplier may seize the supplied good is only 10 days after delivery (Garvin, 1996; Burkart, Ellingsen, and Giannetti, 2010). Therefore, the value of the supplied goods as collateral is limited.

relationship increase their accounts payable during the whole pre-distress period (with the exception of the year in which default occurs).

A cross-sectional analysis reveals that suppliers are more likely to stay with a distressed firm whenever the client has a large concentration of sales, when the supplier sells a large portion of its products to the distressed client, when the supplier sells differentiated goods to the distressed clients, or when the client is located close to the supplier's headquarters. These results suggest that these suppliers have stronger incentives to support their distressed clients, possibly because they are particularly dependent on the survival of their clients for their own survival. That is, they are held up in their relationships with distressed clients.

By complementing our data with information on bank lines of credit, we are also able to show that distressed firms increase their use of pre-committed lines of credit at times when the availability of trade credit is reduced. Previous studies have suggested an inverse relationship in which trade credit is used to substitute for bank credit when the latter is not available (Petersen and Rajan, 1997; Cook, 1999; Garcia-Appendini and Montoriol-Garriga, 2013). Our evidence suggests that trade credit and bank credit are used as complementary sources of credit during normal times, but they can be also used as substitutes when firms have high liquidity needs.

We further analyze the timing when different types of creditors withdraw from a distressed client. Suppliers initially increase their support to distressed clients, but they start decreasing their trade credit provision as early as three to four years before default. Short-term creditors continue to provide support to the distressed clients until well into the year of default. Finally, long-term creditors do not seem to refinance their debts starting the third year before default. We conjecture that the type of contract (implicit or explicit) between the firms and their creditors generate different incentives to support the eventually failed firms. Banks, on the one hand, are contractually required provide credit pre-committed through a line of credit. Moreover, contracts with banks have several features that reduce their losses given default (i.e., seniority (Longhofer and Santos, 2000) and collateral (see e.g. Rajan and Winton, 1995). In contrast, contracts with suppliers are less formal and hence lack a contractual seniority and a formal collateral (Cuñat and Garcia-Appendini, 2012), increasing the incentives of suppliers to exit before other creditors.

The increase in financial support observed in the early stages leading to a default -which is not observed for long-term debt holders, for example- suggests that the client-supplier

relationships are valuable, and that suppliers may benefit from helping their clients in bad times. Theoretically, Wilner (2000) shows that dependent trade creditors grant more concessions to customers in financial distress than what would be granted by lenders in a competitive credit market. Similarly, Cuñat (2007) finds that when clients are hard to substitute suppliers increase trade credit provision to clients that are experiencing temporary liquidity shocks. Empirical evidence which is also consistent with the idea that supplier relationships are valuable include, Hertzel et al. (2008) and Jorion and Zhang (2009), who find that the bankruptcy of a client has a negative impact on the value of the suppliers.[2,3] Similarly, Franks and Nyborg (1996) and Evans and Koch (2007) find that suppliers with private benefits can force inefficient liquidations.

Our paper contributes to the literature on trade credit by analyzing its use by firms in financial distress. To the best of our knowledge, the only study analyzing this issue is Molina and Preve (2012), who find that firms in financial distress use a significantly larger amount of trade credit to substitute alternative sources of financing. Our results qualify their findings by showing that the average increase in the use of trade credit by distressed firms observed in the data is limited to the initial stages of financial distress, but would not hold when a default is imminent. Moreover, we use a supplier-client sample that allows for a deeper understanding of the underlying dynamics on trade credit use as firms approach bankruptcy. In particular, we are able to decompose the change in the use of trade credit into the change in the number of suppliers (extensive margin) and the average trade credit provided by each of them (intensive margin).

More in general, our results provide one explanation for the puzzle that the largest exposures to credit risk following the bankruptcy of a client correspond to junior, unsecured trade credit claims. Our findings suggest that these creditors are likely to be held up with distressed clients due to a dependence relationship. However, suppliers that can more easily substitute their clients exit the distressed relationship and replace the distressed clients with other non-distressed ones.

The remainder of the paper is organized as follows: In Section 2 we describe the data and provide some descriptive statistics. In Section 3 we analyze the evolution of different types of debt as the firms approach the default. Section 4 uncovers the extension of trade credit in the extensive and the intensive margin. In Section 5 we analyze the characteristics of the suppliers

[2] Bankruptcies can also affect the value of lender banks. See for example Dahiya et al (2003).
[3] Relationships are also valuable from the client's perspective: In fact, McMillan and Woodruff (1999) find that suppliers in Vietnam offer more credit when it is difficult for the customer to find alternative suppliers.

that are likely to be held up in a distressed relationship. Finally, we present our conclusions in Section 6.

2. Data and descriptive statistics

We collect quarterly balance sheet data from non-financial, non-government, non-utilities, for-profit Compustat firms from the first quarter of 1976 to the fourth quarter of 2011. Using the delisting files of the Center for Research in Security Prices (CRSP), we identify the distressed firm-quarters in our dataset as those firms which were delisted due to a bankruptcy or an insolvency event (i.e. delist code 574) at any time during our period of observation. We further complement our classification of distressed firms by manually identifying the firms in our dataset that appear in Moody's Ultimate Recovery Dataset (MURD), and as such have gone through a default event, i.e., either a bankruptcy, a distressed exchange, or any missed interest payments on a debt obligation. The MURD dataset identifies milder distress episodes than CRSP, and it has the additional advantage of containing instrument-level information about the defaulted lines of credit up to five years previous to the default event. As we explain below, we also collect this information and use it in some of our analyses.

To be included in our sample, we require that at least one quarter of balance sheet information for each of the distressed firms is available in Compustat within the five-year period previous to distress. With this procedure, we identify 383 distressed firms from MURD, and an additional 418 distressed firms from the CRSP delist files, for a total of 801 distress events and 13,629 quarterly observations on these distressed firms.

The first part of our analysis consists of a comparison of the evolution of debt and trade credit for distressed vs. non-distressed firms. To do this comparison, we match each of the distressed firms identified above to *all* the non-distressed firms in the same industry (defined at the 2-digit SIC code) that were active at the distress date, and that have non-missing balance sheet data for at least one additional quarter within the five-year period leading to distress. To each of the non-distressed firms we assign a fictitious distress date equal to the distress date identified in MURD or CRSP for the corresponding matched distressed firm. We perform the matching with replacement; as a result, some of the non-distressed firms were matched to more than one distressed firm in the same industry.[4] The number of unique firms matched to the distressed firms is 17,278. Due to the procedure of matching with replacement, these firms

[4] The average (median) number of times that a non-distressed firm is matched to a distress event is 9.3 (6).

correspond to 161,268 fictitious distress events. The total number of quarterly observations on these non-distressed firms is 2,398,851. Together with the 13,629 quarterly observations on distressed firms, these observations constitute our base dataset.

A central part of our study consists of analyzing the relationships between suppliers and their clients whenever the latter suffers a distress event. To perform these analyses, we construct a second dataset with information on supplier-client relationships from Compustat's Key Customers Segment file. This segment file contains the names of and the amount of sales to the most important customers (i.e., those clients whose sales represent at least 10% of the total firms sales) for Compustat firms; thus, it allows us to identify the suppliers for which any of the distressed or non-distressed firms in our base sample is an important customer. The information in the Key Customer file contains the Compustat identifier codes (gvkeys) for the suppliers, but text names of the supplier's clients. Therefore, we manually matched the clients' names in the segment files to the Compustat company name records in order to obtain their gvkeys.[5]

To merge the information in the Key Customer file (which has an annual frequency) with our quarterly base dataset, we repeat the names of the clients reported in the yearly segment files for each of the four quarters in the fiscal year, and we linearly interpolate the yearly information on the sales to each client between two consecutive non-missing yearly sales observations of a given supplier-client pair. The resulting database with supplier-customer relationships consists of information from 1,555 unique clients in our base dataset (70 of which are distressed) and 2,878 unique suppliers (293 of which have a distressed client), for a total of 8,005 unique supplier-customer relationships. Our final supplier-customer dataset contains a total of 318,873 quarterly observations on supplier-customer pairs, of which 1,965 correspond to distressed clients.

From our base sample we form a third sample containing information about the use of lines of credit for distressed and non-distressed firms. For this sample, we restrict distressed firms to those reported in MURD, as this data source contains information about lines of credit such as the original amount of each issue, the current limit, and drawn balances up to five years before the distress event. Most of the data points in MURD have a quarterly frequency; however, for some of the firms, information on lines of credit was collected at a yearly or semi-yearly frequency. We converted these observations into quarters by linearly interpolating the variables for a maximum of three consecutive missing quarterly observations between two non-missing

[5] The procedure to manually match firm names in the Compustat Key Customer Segment file is the same as described in Garcia-Appendini and Montoriol-Garriga (2013). Interested readers should refer to that paper to obtain more details about the matching procedure.

observations. After merging this information with balance sheet information from Compustat, we obtained a firm-quarter LOC database consisting of 3,584 firm-quarters associated with distressed firms, corresponding to 379 unique distressed firms.

To obtain information on lines of credit for non-distressed firms, we use the dataset in Sufi (2009).[6] The original dataset contains yearly information on limits and drawn amounts on lines of credit for a random sample of 255 firms between years 1996 and 2003. We discard nine of the firms in Sufi's dataset because they correspond to distressed firms. 49 additional firms in Sufi's dataset correspond to periods or industries for which we have no distressed firms with information on lines of credit from MURD. Therefore, using Sufi's dataset we manage to augment our LOC dataset with information on lines of credit from 197 unique non-distressed firms. As before, we linearly interpolated two consecutive non-missing yearly LOC variables in Sufi's database to obtain quarterly observations. As in our base dataset, we match each distressed firm in the MURD dataset with all the non-distressed firms from Sufi's database in the same industry, and we assign to the non-distressed firms a fictitious distress date corresponding to the distress date of the matched distressed firm. With this procedure we obtain 1,780 fictitious distress events for a total of 20,966 quarterly observations on non-distressed firms.

In each of our databases, we define several accounting variables to analyze the evolution of debt from suppliers and from other sources as firms approach the distress episode. The main variable of interest is the net change in debt from suppliers, defined as accounts payable in quarter t minus accounts payable in quarter $t–1$, divided by assets in quarter $t–1$. For comparison purposes, we also analyze the net issuance of total debt, net issuance of short-term debt, and net issuance of long-term debt (analogously defined as the quarterly difference in total debt (or respectively short- or long-term debt) divided by lagged assets). Our control variables are the log of deflated assets, and the following accounting ratios: property, plant, and equipment to total assets, cash to total assets, total debt to total assets, net worth to total assets, market to book ratio, and percentage change in sales. We also construct the Herfindahl index of market concentration of sales in each industry and period, and for the market share of each firm in each quarter. Additionally, for each supplier-customer pair identified in our subsample of suppliers and customers, we calculate (i) the importance of each client to the supplier (defined as the ratio of sales to that client to total supplier sales), (ii) the number of suppliers selling a large share to each

[6] We thank Amir Sufi for making this data available in his website.

client, and (iii) the distance between the client's and supplier's headquarters.[7] Finally, in the LOC sample we calculate the ratio of the LOC limit to total assets, and the drawn balances to total assets, to observe the evolution of demand and supply of credit for distressed and non-distressed firms.

2.1. Descriptive statistics

Table 1 contains some basic summary statistics for the firms in our base sample (Panel A), as well as for firms in the line of credit sample (Panel B) and in the supplier-customer sample (Panel C and D).[8] Except for clients in the supplier-customer sample, we find that distressed firms are in general larger than non-distressed ones. This is the case because, in order to be included in our sample, suppliers must disclose the names of their most important clients. As such, customers in this sample are likely to be larger than average. Distressed firms have less cash but more tangible assets, have lower net worth and market to book ratios, a lower sales growth ratio, and have a larger market concentration than non-distressed firms. These characteristics are apparent in all of our samples, and highlight the importance of controlling for observable firm characteristics in our subsequent analyses.

Table 1 also shows that in general, distressed firms are more leveraged and use larger amounts of trade credit from their suppliers, as shown by a larger accounts payable to assets ratio. However, the aggregate statistics in Table 1 can conceal the time-variation in the accounting variables of the distressed and non-distressed firms. In the next section we analyze how debt from suppliers and from other debt holders evolves as the firms approach distress.

3. Trade credit and total debt as firms approach distress

3.1. Cross-sectional trends

In this section we provide some descriptive evidence of the evolution of the use of trade credit as firms approach the default event, and how this compares to other types of firm debt. Figure 1 contains the quarterly cross-sectional averages, and 95% confidence intervals, of debt in

[7] To obtain these distances, we geo-code the addresses of suppliers and customers listed in Compustat and use Google Maps to obtain the driving distance, in kilometers, between the two locations.

[8] Notice that in the supplier-customer sample, a firm can appear several times in the same quarter if it has relationships with more than one supplier or client in that quarter. To avoid overrepresentation of firms with multiple relationships, in the descriptive statistics of Panels C and D we consider a single observation per firm and quarter.

trade credit, total debt, short-term debt and long-term debt (Panel A), and debt in lines of credit (Panel B).

The upper left-hand side graph in Panel A shows that the net increase in trade credit, defined as the change in accounts payable divided by lagged assets, is constant and positive at around 0.5 percent of assets for non-distressed firms. In contrast, distressed firms seem to increase their accounts payable at a higher rate (i.e. up to 1 percent of assets) during the fifth and fourth years previous to distress, and then trade credit issuance follows a decreasing trend starting 10 quarters before default. On average, however, distressed firms are still increasing their use of trade credit until three quarters before default, which is when net trade credit issuance by distressed firms becomes significantly negative. This pattern suggests that suppliers start to reduce their support to distressed firms well ahead of default.

Next, we look at other types of debt in order to assess whether suppliers withdraw their support to distressed firms earlier than other creditors. The upper right-hand side graph in Panel A contains the quarterly averages of net total debt issuance, which is similarly defined as the ratio of the change in total debt to lagged assets. This figure shows that during the fifth to the second year before default, net total debt issuance is around 3 percent of total assets for distressed firms, and only around 0.9 percent for non-distressed ones. However, while net issuance of debt continues at 0.9 percent for non-distressed firms during the whole pre-distress period, for distressed firms it starts to fall slowly around six quarters before default and then much more abruptly during the year of the default. Net total debt issuance of distressed firms becomes statistically negative only one quarter before default. When comparing the two figures in the top of Panel A, it seems that suppliers stop lending to their distressed clients somewhat earlier than other debt holders. However, the trends in both types of debt issuance are very similar, and the difference between the exit times of suppliers and other debt holders does not seem to be large.

We next examine the exit times of different debt holders more closely by decomposing total debt into short- and long-term debt. Indeed, trade credit is considered to be short-term debt (Petersen and Rajan, 1997; Ng et al., 1999), so it seems more natural to compare the use of trade credit with the use of short-term debt. The lower graphs in Panel A of Figure 1 show a very distinctive evolution of long-term and short-term debt. Net long-term debt issuance exhibits a similar pattern as the one observed with total debt issuance, although the former starts to decrease slightly earlier, i.e. around eight quarters before default. In sharp contrast, net short-term debt issuance exhibits a significant *increase* during the last two years before default, roughly

coinciding with the period when the issuance of trade credit starts to decrease. The observed sharp increase in short-term debt is likely due to firms drawing heavily on their bank lines of credit (LOC), which generally have a maturity of less than a year.[9] To explore this issue, in Panel B we focus on the sample of firms for which we have information on bank lines of credit. The leftmost figure in Panel B shows the ratio of drawn balances in LOC to total LOC limit. Results show that while non-distressed firms keep the drawn to limit ratio stable at around 30 percent during the whole pre-distress period, distressed firms draw increasing amounts from their lines of credit as they approach default. Indeed, firms seem to have exhausted the entire limit available on the LOC by the time they default. This pattern would explain the sharp increase in short term debt issuance that we observe in Panel A, and is fully consistent with the findings of Jimenez et al. (2009).

Finally, the right-hand side figure of Panel B contains the evolution of the limits of the LOCs as firms approach the distress event. Looking at the limits of the LOCs is useful to gain insights about whether the decreasing trends that we observed in Panel A are driven by a lower supply of credit to distressed firms, or by a lower demand for credit as a result of a lower economic activity or decreasing sales. In fact, LOCs have the useful feature of containing both a LOC limit set by the bank, which can be used as a proxy for the supply of credit from banks, and the amount drawn on these pre-committed credit lines, which is a proxy for the demand of liquidity. Our implicit interpretation of the results so far has been that issuance falls due to a decrease in the supply of credit (i.e. a withdrawal of suppliers or other debt holders from distressed relationships), as we expect that struggling firms with low levels of cash flow would have high needs of external financing. The figure on the right-hand side of Panel B seems to confirm our view, by showing that the supply of credit trends in the opposite direction as the demand for credit when the firms approach default. In fact, the average change in the limit of the LOCs is initially positive and very similar to the supply of credit of non-distressed firms, but it starts decreasing around ten quarters before distress, until it becomes significantly negative around the fourth quarter before default. Therefore, the decrease in overall debt and, specifically, the decrease in accounts payable, is likely to reflect a reduction in credit supply to distressed firms by their creditors, rather than reflecting a lower demand for credit.

[9] Bank LOCs are pre-committed loan contracts with a specific credit limit. Firms can draw down on their credit lines provided that they are not violating any covenant from the contract (see e.g. Sufi, 2009).

Overall, the cross-sectional trends presented in this section suggest that suppliers withdraw their support to distressed firms earlier than other providers of short-term debt. These trends, however, could reflect changes in the composition of our sample in each of the quarters to default. To address this issue, in the following section we perform a regression analysis and include controls for firm and supplier characteristics, as well as firm and supplier-client fixed effects.

3.2. Within-firm trends

To explore whether the previous trends in the debt variables can also be observed within the firms, we estimate the following regression model:

$$DepVar_{it} = \beta_0 + \beta_1 * Default_t + \sum_{k=1}^{4} \beta_{k+1} * Default_{t-k} + \gamma' X_{it} + \delta_i + \varepsilon_{it}. \quad (1)$$

DepVar is one of the following variables: net increase in accounts payable, net debt issuance, net issuance of short-term debt, net increase in the LOC limit, and drawn LOC balance to total LOC limit. For the former three dependent variables, we estimate equation (1) using our base sample in columns 1 to 3, 5 to 7, and 9 to 11 of Table 2; in columns 4, 8, and 12 we use the supplier-customer sample. For the LOC variables we use the LOC sample and present the results in columns 13 to 18 of Table 2. $Default_t$ is a dummy taking the value one in the quarter of default of the distressed firms, zero otherwise; $Default_{t-k}$ are dummies taking the value one if the default occurred k years ahead of quarter t, zero otherwise.[10] X_{it} is a vector of control variables which includes the log of assets, the ratio of tangible assets to total assets, the ratio of cash to total assets, the leverage ratio, the firm's net worth, the sales growth, the Herfindahl index for sales concentration, the market to book ratio, and the net profit margin. Finally, δ_i are firm fixed effects or pair fixed effects in the client-supplier sample. We consider in all estimations up to five years before the default event, such that the coefficients of the default dummies measure the average difference of the dependent variable in the k-th year previous to default, relative to its average value on the fifth year before default. We perform each of the estimations separately within the sample of non-distressed and distressed firms. These estimations will allow us to explore the within-firm evolution of different types of debt.

[10] For ease of interpretation, we use yearly instead of quarterly dummies in the regressions, separating the default quarter to avoid mixing pre-default variables with default variables and therefore confounding the results. However, the results are similar (albeit with larger confidence intervals due to smaller sample sizes for each individual quarter) if we introduce quarterly instead of yearly dummies in the above specification.

Results of the estimations of equation (1) are contained in Table 2. For each dependent variable, we report first a regression that includes only the time dummies indicating time to default and firm fixed effects, without controls. This regression allows for a very simple interpretation of the coefficients: the constant corresponds to the average value of the dependent variable during the fifth year before default, and the rest of the coefficients represent the difference with respect to these values during the *k*-th year before default. To compare the trends for distressed and non-distressed firms, we estimate this simple regression model without control variables both in the sample of distressed and non-distressed firms. Next, for each dependent variable we focus only on the distressed firms and estimate the complete version of equation (1), including firm controls. Finally, in our last specification we use the supplier-customer dataset. The unit of analysis in this specification is a supplier-customer relationship. Therefore, we are able to better control for the supply of trade credit by adding supplier characteristics and for time invariant supplier-client characteristics by including supplier-client pairs fixed effects. Specifically, as additional controls we include the ratio of client to supplier assets, the supplier's market concentration (Herfindahl index) and market share, and change in the supplier's sales.

The within-firm trends obtained in Table 2 are very similar to the cross-sectional ones observed in Figure 1. We begin by analyzing the use of trade credit in columns 1 to 4. Results in column 1 show that, in spite of a very mild negative trend, non-distressed firms experience a positive issuance of trade credit of about 0.7 percent of assets per year throughout the pre-distressed period. Turning to distressed firms, column 2 shows that the unconditional, within-firm net issuance of accounts payable by distressed firms is positive and stable at around 0.9 percent during the fifth, fourth, and third years previous to default. Two years before default, however, the pace of net issuance decreases by 0.48 percentage points with respect to the fifth year, that is, it is less than half of what used to be in the previous years. This decreasing trend accelerates and, indeed, net trade credit issuance becomes negative during the year before default. The estimated coefficient for *Default-1* implies that distressed firms are reducing their use of trade credit at a rate of 0.3 percent of assets the year before default, and this is statistically significant at the 1% level. The results for distressed firms are similar to those in column 2 when we control for firm characteristics (column 3), and in the matched supplier-client sample with pairs fixed effects (column 4).

Columns 5 to 8 show that the observed pattern in trade credit is similar for total debt from other debt holders. For non-distressed firms, results in column 5 show that annual net total debt

issuance is around 1.25 percent of assets during the fifth year previous to the distress. Unconditional within-firm results in column 6 show that the net issuance of total debt by distressed firms is positive and stable at around 2.7 percent during the fifth, fourth, and third years previous to default. However, two years before default, distressed firms reduce their pace of net debt issuance to just 1.9 percent, but it remains on average positive. The year before default it turns negative, which implies that distressed firms are reducing their total debt levels by 0.2 percent of assets. Results for distressed firms are robust to the inclusion of firm controls (column 7), but are no longer significant when we estimate the regression in the matched supplier-client subsample including pair fixed effects (column 8).

As with its cross-sectional counterparts, the results discussed so far suggest that the average debt holder exits distressed firms about the same time as suppliers do, i.e., during the second year previous to default. However, given the short-term nature of trade credit, it is more relevant to compare the trends in this variable with the issuance of short-term debt. The results for the latter variable, contained in columns 9 to 12, show a very large, positive, and significant coefficient for distressed firms during the year before distress. Unconditional within-firm results in column 10 imply that the net issuance of short-term debt *increases* by 2.3 percent during the year previous to default, a very large increase compared to an average issuance of 0.6 percent in the fifth year. In contrast, non-distressed firms maintain their issuance of short-term debt at 0.4 percent of assets throughout the pre-distress period.

As mentioned when we were discussing the cross-sectional results in Figure 1, this sharp increase in short term debt is likely due to distressed firms drawing heavily on their lines of credit (LOC), which generally have a maturity of less than a year. To explore this issue, in Panel B we focus on the sample of firms for which we have information on bank lines of credit. The within-firm estimations for lines of credit show that non-distressed firms on average increase their LOC limits (albeit at decreasing rates) during the whole pre-distress period (column 13). The negative trend in the supply of credit for non-distressed firms is consistent with the finding that a distress in an industry can reduce the supply of credit for the non-distressed competitors (Lang and Stulz, 1992; Jorion and Zhang, 2007; Benmelech and Bergman, 2011; Hertzel and Officer, 2012).

Distressed firms also exhibit a negative trend in the supply of credit; however, in contrast to non-distressed firms, distressed firms have important reductions in their LOC limits one year before default. In fact, the coefficient in column 14 suggests that LOC limits are reduced on average by 0.7 percentage points during this year, and this is statistically significant at the 1%

level. This pattern is in stark contrast with the drawn balances in the LOCs (columns 16-18). While non-distressed firms keep their drawn balance to total LOC limit constant at around 32 percent during the whole pre-distress period, distressed firms significantly increase this balance as early as four years before the distress event. Indeed, demand for liquidity is so high that by the date of distress, firms have practically exhausted their credit limits. Therefore, the large increase in short term debt one year before default is likely reflecting the heavy use of LOCs by distressed firms.

The results on LOCs presented in Panel B also suggest that the decrease in accounts payable and in debt issuance that we observe in Panel A are driven by a reduction in the supply of credit of firms in financial difficulties. As discussed in the previous section, the fact that the trends in the limits on the LOCs and the drawn balances in the LOCs are inverted suggests that distressed firms have a high demand for liquidity when they are close to distress, precisely when credit supply becomes tighter.

To conclude this analysis, we perform conditional within-firm estimations of polynomial equations that allow us to observe the times (relative to the default event) in which trade credit and short-term debt reach their maximum levels. We interpret these peaks at the times in which creditors withdraw their support from their clients. The results, which are reported in the appendix, show that trade credit issuance of distressed firms is initially positive and increasing, it peaks 13 quarters before distress, and then it decreases until it becomes negative around 3 quarters before default. In contrast, issuance of short-term debt is initially negative but it increases until it becomes positive 7 quarters before default. Then, it continues to increase until 3 quarters before default, when it reaches its peak and then falls until default. However short-term credit issuance remains positive until the default quarter. These results suggest a difference of 10 quarters between the peaks of trade credit and short-term credit, suggesting that suppliers exit from distressed firms on average 10 quarters before other short-term debt holders.

Overall, the results in this section confirm the unconditional cross-sectional trends observed in Figure 1. These results suggest that suppliers and other short-term debtors show quite different behavior when their clients are close to distress. On average, suppliers tend to withdraw from their distressed relationships early. In contrast, other short-term debt holders provide short-term liquidity support to their distressed clients, most likely through instruments such as lines of credit (Sufi, 2009).

The differences between short-term debt issuance and the net increase in accounts payable observed above possibly reflect the variation in the contracts held by each type of debt holder. On the one hand, LOC contracts have features that reduce their losses given default, such as seniority (Longhofer and Santos, 2000) and collateral (see e.g. Rajan and Winton, 1995). In addition, banks have access to a more diversified portfolio of borrowers relative to suppliers, as they are not limited by industry or market concentration constraints. Because they reduce the banks' losses given default, these mechanisms increase the probability of lending to or renegotiating with distressed firms relative to other unsecured, junior and less diversified creditors. In contrast, contracts with the suppliers are much less formal than bank LOCs, and they lack both contractual seniority and formal collateral (Cuñat and Garcia-Appendini, 2012).[11,12] Thus, it is optimal for suppliers that start losing confidence on their clients' repayment ability to progressively withdraw their support to distressed clients, as we observe in the graphs. This is consistent with the results of Baxter (1967), Titman (1984), and Andrade and Kaplan (1998).

However, these results contrast with previous evidence that has found that the largest exposures to bankrupt firms correspond to trade credit (Jorion and Zhang, 2009; Evans and Koch, 2007). Indeed, if all suppliers would exit from their distressed relationships, we should find that the exposures of trade creditors to bankrupt firms goes to levels very close to zero. In the next section, we further explore the supplier-customer sample in order to analyze how much of the reduction in trade credit is due to a change in the number of suppliers (extensive margin) and how much can be attributed to a smaller credit provision by each of them (intensive margin). This analysis should bring insights as to whether there are some suppliers that are more likely to suffer larger exposures from a distressed relationship.

4. Supplier-client relationships as firms approach distress: extensive and intensive margin

4.1. Extensive margin

In this section, we estimate a slightly modified version of equation (1) that allows us to explore the evolution of the supplier-customer relationship as clients approach default. Specifically, we estimate the above equation on the supplier-customer sample, adding client-

[11] In fact, the short-term nature of trade credit can be explained as a way a form of gaining effective seniority relative to other claimants (Longhofer and Santos, 2003).

[12] Some theories claim that one advantage of suppliers is that the good they supply can serve as collateral. In the US, however, the legal period over which a supplier may seize the supplied good is only 10 days after delivery (Garvin, 1996).

supplier specific variables as controls, and using as dependent variable the number of suppliers selling to the clients. Next, we also estimate this equation using the log of the geographical distance between the client's and the supplier's main headquarters as dependent variable, in order to analyze whether the suppliers that stay with the distressed firms are located more closely or further away from the distressed firms. Distance is generally used as a proxy for the information advantage of lenders and strength of the relationship. For these estimations, we include client fixed effects so that we can observe how the average number of suppliers to a given client, or the average distance between a given client and all his suppliers, changes as the client approaches default.

Our results in column 2 of Table 3 show that the number of suppliers providing credit to distressed clients drops well ahead of default. In particular, the number of suppliers decreases sharply by more than 5 during the third year before default. The average number of suppliers to a distressed client continues to decrease during the second year and the year before default by about one more. These results are qualitatively robust to the inclusion of client and supplier controls (column 3). These results suggest that suppliers of distressed firms exit these relationships well ahead of default, i.e. a strong reduction of supplier support to their distressed clients in the extensive margin. In contrast, the results in column 1 show that the number of suppliers of non-distressed clients exhibits a slightly positive trend. More specifically, over the course of the five year period leading to distress, non-distressed clients gain on average about one additional supplier. This result is consistent with suppliers partially substituting their distressed client with other clients in the same industry.

To illustrate this finding, we perform the cross-sectional counterpart of these within-firm trends in Figure 2. The figure shows that the average number of suppliers reporting the distressed firms as one of the most important clients decreases strongly from around 24 suppliers five years previous to distress to around 10 to 13 suppliers at distress. In contrast, for the non-distressed firms the average number is around 9 and it remains constant throughout the whole period. As in the within-firm regressions of Table 3, this cross-sectional result suggests that a significant fraction of suppliers exit their relationships with distressed clients well ahead of the default event, in other words, that supplier support to distressed firms decreases in the extensive margin.

Next, we analyze the evolution of the distance between clients and their suppliers as the client goes towards default. The estimations in columns 5 and 6 of Table 3 suggest that the distance from distressed clients to their suppliers decreases three years before default, coinciding

with the year when more suppliers exit their relationships. In contrast, in column 4 we find that for non-distressed clients the average distance to their suppliers increases slightly during the fourth, third, and second years previous to the default. These results imply that those suppliers that are further away from the distressed client are the first to leave the distressed firms, possibly to substitute them with other non-distressed firms. Therefore, our results do not provide support for theories of trade credit that pose that suppliers withdraw from distressed relationships early because they have better or timelier information about the underlying credit quality of firms (Biais and Gollier, 1997; Burkart and Ellingsen, 2004). Instead, suppliers that are situated closer to their clients continue to support financially their distressed clients. This is consistent with the view that suppliers and customers that are closer to each other establish more valuable relationships (Ellison et al., 2010). This result is also consistent with the idea that suppliers that are closer to their clients are more susceptible of being held up and, therefore, continue the relationship with distressed clients. The analyses in the following sections shall provide more light into these issues.

4.2. Intensive margin

In the previous section we found that a significant number of suppliers exit their distressed relationships well ahead of default. To further investigate whether the suppliers that stay in distressed relationships provide more support to their clients in the intensive margin, we divide suppliers into those that continue the relationship up to two quarters before default and those that end the relationship before. We define the dummy variable *Supplier stays* taking the value one when the supplier continues to sell to the distressed firms two quarters before the default event, and zero otherwise. An unreported univariate analysis shows that those suppliers that continue the relationship have stronger relationships with distressed clients: on average, sales to the distressed client represent 14.0% of their total sales compared to 11.6% of suppliers that terminate the relationship. Furthermore, suppliers that continue the relationship are closer (average distance is 1,246 km) than those that terminate the relationship (average distance is 1,488 km). In Section 4, we shall analyze more formally the characteristics of the suppliers that stay in the distressed relationship.

To analyze the evolution of the supplier-client relationship in the intensive margin, we augment equation (1) by interacting each of the five time to default dummies with the dummy variable *Supplier stays.* The interaction terms capture the differential evolution of the dependent

variables for suppliers that continue the relationship with the distressed client with respect to those that terminate it. We construct three different dependent variables that measure the intensity of the relationship between a client and its supplier: (i) the log of the supplier's sales to a client; (ii) the log of the supplier's sales to a client scaled by total supplier sales, and (iii) the client's net issuance in accounts payable. [13] We estimate the augmented equation twice for each dependent variable: once without control variables for client and supplier characteristics and the second one including such controls. Because the dependent variables exhibit variation over time within a supplier-client pair, we include pair fixed effects and hence we are analyzing the within-pair trends in sales and trade credit as firms approach default.

In columns 1 and 2 of Table 4 we use the supplier's sales to a distressed client as dependent variable. The negative coefficients of the time to default dummies imply that on average suppliers decrease the amount of sales to clients as they approach default. For suppliers that continue the relationship, however, the positive interaction terms imply that they actually *increase* their sales to distressed clients. For example, the coefficients of the two years before default dummies imply that suppliers that terminate the relationship decrease their sales to distressed clients by 25% in that year with respect to five years to default, while they increase them by 12% when the supplier stays. When we include supplier and client controls in column 2, the interaction terms are no longer significant, but they are all positive, suggesting that suppliers that stay with distressed clients do not reduce their sales as time to distress approaches.

In a way, this result may seem counterintuitive, as suppliers should try to minimize their losses in the event of default. However, it seems that suppliers are also increasing their sales to other clients. To see this, in columns 3 and 4 we analyze the evolution of the relative importance of the client for the supplier, by using the supplier's sales to a distressed client scaled by total supplier sales. In contrast to column 1, the interaction coefficients in column 3 are not significant, albeit they are all positive, which suggests that even for suppliers that continue the relationship, their exposure to distressed clients is not increased.

Most importantly, in columns 5 and 6 we analyze the evolution of net trade credit issuance by distressed clients. We find that distressed firms significantly reduce their issuance of debt in accounts payable during the five year period leading to distress, especially in the year before default. The coefficient of the *Default -1* dummy in column 5 implies a reduction of 8% with respect to the issuance five years before default. However, distressed firms with suppliers

[13] Ideally we would like to use accounts payable to each supplier but this information is not available to us.

that continue the relationship experience a much smaller decrease in their debt in accounts payable compared to the clients with suppliers that exit. In particular, the interaction term *Default -1* Supplier stays* implies a reduction of net trade credit issuance of just 1% with respect to five years before default. These results also hold after adding all controls, in column 6.

Overall, the results in this section suggest that suppliers that continue the relationship increase their sales to distressed clients in the extensive margin, and do not reduce their extension of trade credit as much as those suppliers that exit the relationship earlier. These results imply that stronger and stable relationships with suppliers are beneficial to firms in financial distress. But, why should suppliers provide financial support to distressed clients? In the following section, we aim to shed some light into this issue by analyzing the characteristics of the supplier-client relationships and the market where these firms operate in order to understand the suppliers' incentives to provide financial support to distressed clients. As we shall see, the evidence suggests that suppliers that depend on their clients are more likely to be held up in a distressed relationship.

5. Hold-up in distressed relationships

In this section, we examine which characteristics of the product market and the supplier-client relationships are correlated with the probability that the relationship survives at least up to two quarters before the client defaults. Several theories of trade credit suggest that some features of the product market, such as the degree of specificity of the goods supplied to the clients, or the market concentration of clients' sales, could make the supplier more likely to be held up in a distressed relationship. Likewise, the distance to the client's headquarters, or the importance of the distressed clients in the supplier's portfolio, could affect the probability of the supplier to terminate the relationship at the first signs of distress.

For this analysis, we use the supplier-customer sample, restricting the observations to the subsample of distressed clients. The dependent variable is a dummy taking a one when the supplier stays in the relationship at least two quarters previous to the distress event, and zero if the supplier exits three quarters before distress or earlier. Unreported descriptive statistics reveal that 44 percent of the suppliers stay with their distressed clients until at least two quarters before default, while the remaining 66 percent exit well before distress. Because this dependent variable is fixed over the whole pre-distress period, we start the analysis by performing cross-sectional regressions in columns 1 to 5 of Table 5. As independent variables, we include the following

product market and supplier-client relationship characteristics: average Herfindahl index of sales concentration in the client's product market during the fifth year before distress, a dummy variable taking a one if the client is important for the supplier (i.e., if the sales of the supplier to the distressed client were larger than the median during the fifth year previous to distress, and zero otherwise), distance from the supplier's to the client's headquarters, and a dummy variable taking a one if the good supplied to the client is differentiated, zero otherwise. We also include controls for the size of the supplier and the size of the client. Results in Table 5 show coefficients estimated with a linear probability model, however the results are qualitatively unchanged when we use a non-linear probit model.

Results in column 1 show that suppliers are more likely to support their distressed clients when the client operates in a more concentrated product market. This result suggests that in these cases the supplier cannot substitute the distressed client as easily as in a competitive market, and hence is held up in the distressed relationship as described by Wilner (2000). In particular, the coefficient implies that the probability that suppliers stay with distressed clients is 17 percentage points higher in concentrated markets than in more competitive markets.

Also in line with Wilner's (2000) theory, the results in column 2 show that when the client is important to the suppliers, they are more likely to continue the relationship with distressed clients. When the sales portfolio of a supplier is very concentrated towards the distressed client, then the supplier has a larger stake at risk should the client go into bankruptcy, and it is likely that his own survival depends strongly on his client's survival. The coefficient implies that the probability of staying with the distressed firm is 13.5 percentage points higher when the client is important.

We next analyze the role of distance between the supplier and the distressed client as a determinant of whether the supplier stays longer in a distressed relationship. The negative coefficient in column 3 implies that suppliers that are closer to their clients are more likely to remain longer in a distressed relationship. To the extent that distance is a proxy of the information available to the supplier about its client's creditworthiness, this result does not provide support for the information advantage theories of trade credit (i.e. Biais and Gollier, 1997 or Burkart and Ellingsen, 2004). These theories would suggest that suppliers have timelier information than other creditors and hence more informed suppliers should exit their distressed relationships earlier. Rather, the result is consistent with suppliers and clients choosing to co-locate close to each other to reduce costs of doing business (see e.g. Ellison and Glaeser, 1999).

Suppliers that are relatively close to their clients are more likely to be held up in distressed relationship because the cost of substituting these clients with other customers which are further away is higher.

In column 4 we include a dummy variable equal to one if the supplier sells differentiated goods.[14] Theory suggests that differentiated goods, which are often tailor-made for the client, are more difficult to resell than standardized goods or services (Burkart, Ellingsen and Giannetti, 2011). Therefore, suppliers selling this type of goods are more likely to be held up in a relationship. Consistent with this idea, we obtain a positive coefficient for the differentiated goods dummy, implying that suppliers are more likely to stay in the relationship with a distressed client when the good sold is differentiated. However, the coefficient is not statistically distinguishable from zero.

In column 5 we include all significant variables into the regression, and the signs of the independent variables found before remain unchanged. However, the statistical significance of the coefficients is lower, possibly due to the reduced sample size.

A distinctive feature of our supplier-client paired sample is that a given client may have multiple suppliers in each time period. Therefore, we can include client-time fixed effects, which allows us to control for time-*varying* client unobserved heterogeneity. This specification captures the within-client variation across different suppliers, and therefore, we cannot include client-specific variables (in particular, the client market concentration, or controls for client size) because they are subsumed with the fixed effects.

Our results with client-time fixed effects, which are reported in columns 6 to 9 of Table 5, largely confirm the cross sectional results obtained before. In column 6 we find that suppliers that have a large share of sales to the distressed firms are more likely to stay longer in the relationship. That is, given a client, important relationships are more likely to survive. The economic magnitude estimated in the fixed effects regressions is larger than in the cross-section, suggesting that when the client is important suppliers are 17.9 percentage points more likely to stay in the distressed relationship. Next, in column 7 we find a negative effect of distance, suggesting as before that suppliers that are located closer to their clients are more likely to continue the relationship. However, in contrast to the cross-sectional results this variable is not statistically significant. Similarly, in column 8 we find that for a given client, suppliers that

[14] We classify suppliers into producers of standardized goods, differentiated goods, and services, using the definition in Burkart, Ellingsen, and Giannetti (2011).

provide differentiated goods are more likely to stay in the distressed relationship than other suppliers. The coefficient is statistically significant, and it implies that a supplier of differentiated goods is 25 percentage points more likely to stay in a distressed relationship than suppliers of standardized goods or services. Finally, in column 9 we run the fixed-effects regression including all statistically significant variables, and the results remain unchanged.

To summarize, the results in this section suggest that product market characteristics, as well as the features of the relationship between the client and the supplier, are important factors to determine whether the suppliers are more likely to continue with their relationship with a distressed client. Indeed, our findings are consistent with the idea that suppliers continue their distressed relationships because they are held up.

6. Conclusions

Using a sample of firms matched with their suppliers and detailed information on the use of bank lines of credit, we show that in the extensive margin, the number of suppliers providing credit to distressed clients drops well ahead of default. Under some situations, however, the supplier has an important implicit stake in its customer's business. These situations force suppliers to support their customers for a longer time period, and with larger financial commitments. Our empirical findings show how such a dependency situation arises whenever the vendor sells a large fraction of its produce to one particular customer, whenever the distressed client has a large concentration of sales, for the supply of differentiated goods, or when the supplier is located close to the distressed firm. In these cases, we find a positive effect on the intensive margin as those suppliers that continue the relationship with a distressed client marginally increase their sales and provision of liquidity.

Finally, we find that suppliers tend to leave their distressed clients earlier than other short-term debtors. This evidence is consistent with trade credit being junior and de-facto uncollateralized. However, we also find that the average supplier initially increases his support to distressed clients, in an early distress stage. This phenomenon suggests that trade credit relationships are valuable, and it is fully consistent with Wilner's (2000) and Cuñat's (2007) models which explain the higher equilibrium price of trade credit (relative to bank credit) with an insurance premium paid by the potentially benefitted customers.

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A. Appendix: Who exits first?

In this section we examine whether suppliers or other debt holders such as banks are more likely to withdraw their financial support from a distressed relationship earlier. Formally, most legislations regard trade credit as one of the most junior forms of credit; therefore, any outstanding unsecured trade credit would normally end up at the end of the debt priority queue in case of bankruptcy. This fact, together with the short term nature of trade credit and good information on the seller's side (Biais and Gollier, 1997) should increase the incentives of suppliers to exit earlier than other debt holders whenever their clients are in financial distress and hence facing a potential default. However, if suppliers incur sunk costs that are specific to their buyers, or if they are largely dependent on the survival of their customers for their own continuation (Wilner, 2000), then suppliers could give more concessions to their customers than banks, and incentives to exit a distressed relationship should be weaker for suppliers than for banks.

To analyze this question, we focus on the sample of distressed firms and estimate polynomial functions of order 0, 1, …, and 5 of different measures of debt issuance on the time to distress, as follows:

$$DebtIssuance_{ijt} = \sum_{k=0}^{M} \beta_k \, t^k + \gamma' X_{it} + \delta_i + \varepsilon_{it} \qquad (2)$$

In the above model, t is the number of quarters remaining until distress, and M= 0, 1, …, 5 are integers that determine the order of each polynomial as a function of the time to distress. As before, X_{it} is a vector of control variables which are likely to determine the amount of debt or trade credit issued by the firm, and contains the size of the firm (log of assets), its leverage ratio (debt to assets), the ratio of property, plant, and equipment to assets, Q, market share, and change in sales. Finally, δ_i represent firm fixed effects.

To analyze whether suppliers or other debt holders withdraw their financial support earlier, we estimate Equation 2 on our base sample using net debt issuance and net increase in accounts payable as dependent variables, and we compare the time trends implied by the polynomials that best fit the data for each dependent variable. To determine which is the order of the polynomial that best fits the data, we choose the largest polynomial degree in which all the coefficients β_k, $(k = 1, \dots, M)$ are individually statistically significant, and for which the joint test of hypothesis $\{\beta_k = 0, k = 1, \dots, M\}$ is rejected. Then, we graph the estimated polynomials that best fits the data as a function of the number of quarters to distress, assigning for each of the included control variables constant values equal to their average over the estimation sample.

Panel A of Figure 3 contains the time trends for the polynomials that best fit the data net debt issuance and net increase in trade credit. The estimated coefficients and corresponding tests of hypotheses are contained in the Appendix Table A.1.

Our results in Panel A of Figure A.1 do not show significant differences between the trends in the evolution of trade credit and other debt through time. In fact, the estimated polynomials for both dependent variables suggest that firms initially increase their issuance of both debt and trade credit; however, starting around 13 quarters preceding distress the average firm decreases its issuance of trade and bank credit, first slowly, and in a steeper way starting around 4 quarter before distress.

We next estimate Equation (2) using the net issuance of short- and long-term debt, respectively. The results, shown in Panel B of Figure A.1, display notable differences between debts of different maturities. Short-term debt issuance displays a positive trend, and it peaks at only three quarters previous to default. This figure suggests that short-term debt holders increase their support to distressed firms, possibly through lines of credit. In contrast, long-term debt holders slowly withdraw their support to distressed creditors. The trends of trade credit issuance is somewhat in between short-term issuance and long-term issuance.

Table 1. Descriptive statistics

This table contains descriptive statistics for the three samples used in our analyses: The base dataset (Panel A), the sample with information on lines of credit (Panel B), and the sample of suppliers-customer relationships (Panel C and D). In each panel, descriptive statistics are calculated over the subsamples of non-distressed and distressed firms, respectively. Notice that in the supplier-customer sample, a firm can appear several times in the same quarter if it has relationships with more than one supplier or client. To avoid overrepresentation of firms with multiple relationships, in Panels C and D we consider a single observation per firm and quarter

Panel A: Whole sample

	Non-distressed firms				Distressed firms			
	N	mean	median	standard deviation	N	mean	median	standard deviation
Log of real assets	2,398,851	4.584	4.516	2.460	13,629	5.657	5.736	1.819
Debt to total assets	2,281,322	0.274	0.182	0.389	12,973	0.488	0.450	0.364
PPE to total assets	2,384,466	0.277	0.200	0.244	13,580	0.343	0.297	0.238
Cash to total assets	2,377,268	0.202	0.094	0.241	13,535	0.097	0.031	0.164
Net worth to total assets	2,396,460	0.403	0.524	0.738	13,622	0.183	0.249	0.537
Herfindahl index sales concentration	2,716,514	0.142	0.105	0.114	14,780	0.173	0.131	0.135
Market to book ratio	1,930,633	3.214	1.567	6.015	10,569	1.793	1.158	3.126
% change in sales	2,359,422	0.102	0.031	0.525	13,411	0.080	0.014	0.489
Accounts payable to total assets	2,357,090	0.125	0.078	0.171	13,519	0.125	0.094	0.120

Panel B: LOC sample

	Non-distressed firms				Distressed firms			
	N	mean	median	standard deviation	N	mean	median	standard deviation
Log of real assets	22,253	5.518	5.538	1.986	3,673	6.486	6.353	1.272
Debt to total assets	21,449	0.218	0.202	0.179	3,519	0.644	0.616	0.299
PPE to total assets	22,253	0.281	0.236	0.210	3,669	0.352	0.327	0.220
Cash to total assets	22,253	0.128	0.053	0.162	3,666	0.048	0.021	0.079
Net worth to total assets	22,253	0.540	0.537	0.210	3,673	0.060	0.111	0.314
Herfindahl index sales concentration	22,253	0.149	0.101	0.141	3,795	0.171	0.135	0.132
Market to book ratio	20,447	1.900	1.425	1.531	2,346	1.332	1.081	0.962
% change in sales	20,965	0.036	0.018	0.223	3,323	0.024	0.004	0.244
Accounts payable to total assets	21,828	0.091	0.071	0.070	3,658	0.106	0.086	0.078
LOC limit to total assets	20,966	0.206	0.170	0.152	3,486	0.231	0.181	0.175
Drawn amount to LOC limit	20,966	0.298	0.209	0.308	3,584	0.539	0.573	0.338

Panel C: Clients in client-supplier database

	Non-distressed firms				Distressed firms			
	N	mean	median	standard deviation	N	mean	median	standard deviation
Client variables								
Log of real assets	25,850	8.403	8.643	1.943	616	8.310	8.330	1.840
Debt to total assets	24,390	0.236	0.225	0.167	594	0.377	0.341	0.216
PPE to total assets	25,670	0.313	0.269	0.206	616	0.353	0.331	0.195
Cash to total assets	25,714	0.127	0.070	0.149	613	0.090	0.047	0.109
Net worth to total assets	25,827	0.445	0.444	0.206	616	0.207	0.186	0.228
Herfindahl index sales concentration	27,423	0.150	0.109	0.129	635	0.166	0.095	0.160
Market to book ratio	19,084	2.132	1.586	1.630	471	1.422	1.160	0.875
% change in sales	22,221	0.034	0.025	0.184	536	0.033	0.018	0.213
Accounts payable to total assets	25,356	0.109	0.085	0.086	608	0.135	0.106	0.099
Client-supplier variables								
Sales to client / total supp. sales	69,495	0.155	0.083	0.225	1,912	0.130	0.063	0.211
Client-supplier distance (km)	61,594	1,796	1,458	1,492	1,762	1,349	882	1,348
Number of suppliers	72,963	8.963	4.000	10.229	1,965	15.318	8.000	15.206

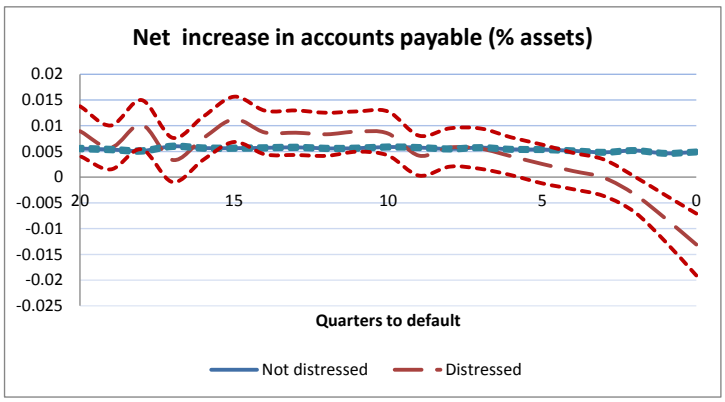
Panel D: Suppliers in client-supplier database

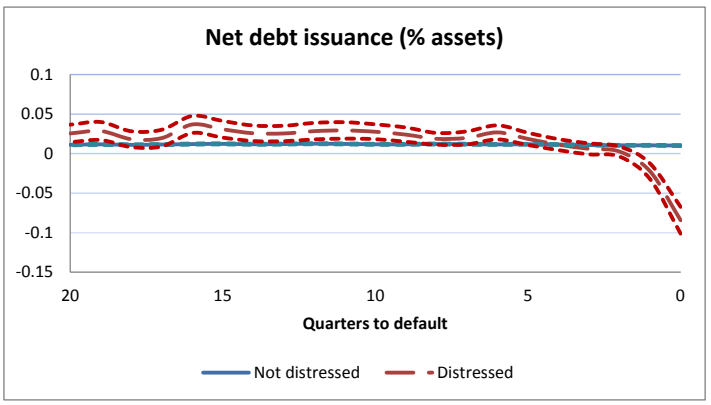
	Suppliers of non-distressed firms				Suppliers of distressed firms			
	N	mean	median	standard deviation	N	mean	median	standard deviation
Supplier variables								
Log of total assets	48,426	5.113	4.992	2.062	1,047	5.847	5.830	1.930
Accounts receivable to total assets	47,645	0.180	0.163	0.126	1,029	0.162	0.131	0.125
% change in sales	46,540	0.067	0.029	0.351	1,018	0.075	0.025	0.405
Herfindahl index sales concentration	48,426	0.151	0.108	0.133	1,047	0.154	0.109	0.124
Market share	48,349	0.024	0.002	0.068	1,043	0.026	0.002	0.061

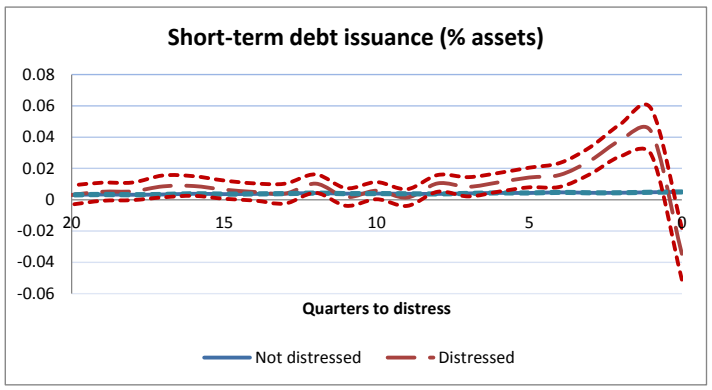
Figure 1. Cross-sectional trends in use of debt and lines of credit as firms approach default

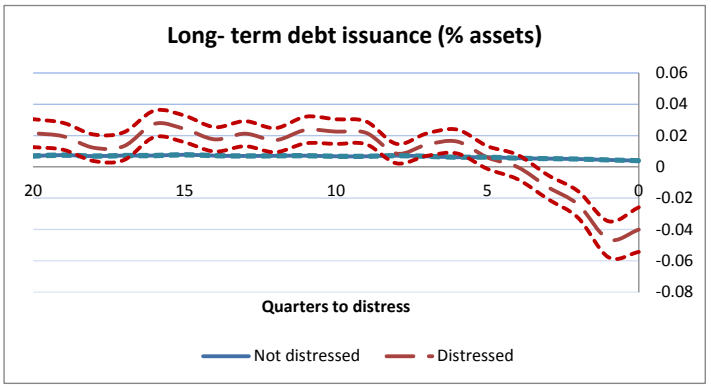
This figure contains the cross-sectional point estimates and 95% confidence intervals for the quarterly averages of the following variables: net increase in accounts payable as % of assets, net debt issuance as % of assets, net short-term issuance as % of assets, net long-term issuance as % of assets, net increase in LOC limit as % of assets, ratio of drawn LOC balance to LOC limit. Averages are calculated separately for distressed firms and the matched non-distressed firms in the same industry.

Panel A: Debt and trade credit

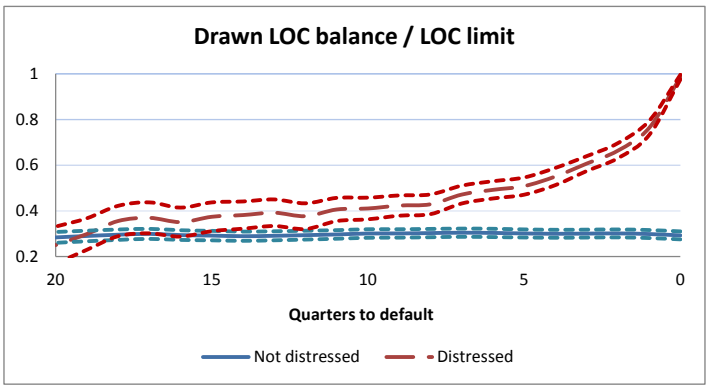








Panel B: Use of lines of credit



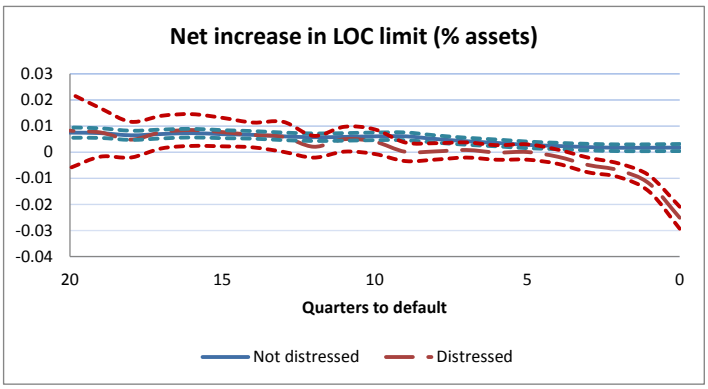


Table 2. Within-firm evolution of trade credit and other debt as firms approach distress

The dependent variables are: net increase in accounts payable (columns 1-4), net debt issuance (columns 5-8), net short-term issuance (columns 9-12), net increase in LOC limit (columns 13-15) and drawn LOC balances to total LOC limit (columns 16-18). Independent variables are: Default (a dummy taking a one in the quarter of default zero otherwise), and Distress -k, k=1 to 4, which are four dummy variables taking a one during the k-th year before default, zero otherwise. We also include but do not report the following firm-level controls: log of assets, tangible assets to total assets, cash to total assets, leverage ratio, net worth, sales growth, Herfindahl index for sales concentration, market to book ratio, and net profit margin. In columns 4, 8, and 12 estimations are done over the subsample with information on clients matched with their suppliers, and the additional controls were added: ratio of client to supplier size, supplier's market share and Herfindahl index, and supplier's change in sales . In columns 13 to 18 estimations are done over the subsample with information on lines of credit. Estimations include up to 20 quarters of information before the default date. Distressed firms are matched to all non-distressed firms in the same industry, assigning to them the date of the default of the matched distressed firm. Standard errors are clustered at the firm level. ***, **, and * means statistically significant at the 1, 5, and 10%, respectively.

Panel A. Accounts payable and total debt

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES:	Net increase in accounts payable				Net debt issuance				Net short term debt issuance			
SAMPLE:	Base sample			Client-supp	Base sample			Client-supp	Base sample			Client-supp
	No Distress	Distress	Distress	Distress	No Distress	Distress	Distress	Distress	No Distress	Distress	Distress	Distress
Default quarter	-0.00440***	-0.0214***	-0.0201***	-0.0871***	-0.00363***	-0.111***	-0.111***	-0.00110	0.00106***	-0.0406***	-0.0448***	0.00283
	[0.000198]	[0.00323]	[0.00409]	[0.0180]	[0.000474]	[0.00958]	[0.0110]	[0.0172]	[0.000279]	[0.00870]	[0.0105]	[0.0176]
Default - 1	-0.00345***	-0.0118***	-0.00995***	-0.0623***	-0.00262***	-0.0282***	-0.0441***	-0.00809	0.000805***	0.0234***	0.0108***	0.0109
	[0.000144]	[0.00124]	[0.00186]	[0.0106]	[0.000385]	[0.00360]	[0.00517]	[0.0161]	[0.000206]	[0.00270]	[0.00381]	[0.00880]
Default - 2	-0.00188***	-0.00484***	-0.00600***	-0.0174***	-0.00103***	-0.00785**	-0.0230***	-0.0146	0.000412**	0.00448**	-0.00586**	-0.000778
	[0.000128]	[0.00121]	[0.00153]	[0.00604]	[0.000342]	[0.00359]	[0.00419]	[0.0129]	[0.000183]	[0.00199]	[0.00267]	[0.00628]
Default - 3	-0.000848***	-0.00120	-0.00246*	-0.0217***	-0.000127	0.000651	-0.00866**	-0.00774	0.000457***	-0.00185	-0.00924***	-0.000905
	[0.000111]	[0.00121]	[0.00147]	[0.00616]	[0.000299]	[0.00375]	[0.00417]	[0.0117]	[0.000167]	[0.00169]	[0.00226]	[0.00574]
Default - 4	-0.000257***	0.00108	0.00106	-0.00685**	0.000319	0.00454	0.000353	-0.00293	0.000391***	0.000171	-0.00506**	0.00212
	[9.50e-05]	[0.00120]	[0.00138]	[0.00320]	[0.000239]	[0.00390]	[0.00441]	[0.00963]	[0.000140]	[0.00196]	[0.00234]	[0.00529]
Constant	0.00706***	0.00860***	-0.0246*	-0.270***	0.0125***	0.0267***	-0.141***	-0.593***	0.00363***	0.00621***	-0.0900***	0.0347
	[8.97e-05]	[0.000830]	[0.0127]	[0.0753]	[0.000245]	[0.00260]	[0.0293]	[0.187]	[0.000132]	[0.00132]	[0.0172]	[0.0887]
Observations	2,207,296	12,930	9,302	798	2,113,718	12,286	9,203	669	2,127,770	12,377	9,218	669
R-squared	0.001	0.011	0.045	0.209	0.000	0.035	0.113	0.302	0.000	0.018	0.078	0.223
Number of firms	138,988	785	659	172	137,014	773	651	138	137,308	773	651	138
Controls	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Pair FE	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes
Firm FE	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No

Table 2 (continued)
Panel B. Debt from lines of credit

	(13)	(14)	(15)	(16)	(17)	(18)
VARIABLES:	Net increase in LOC limit			Drawn balance to LOC limit		
SAMPLE:	LOC sample			LOC sample		
	No Distress	Distress	Distress	No Distress	Distress	Distress
Default quarter	-0.0107***	-0.0340***	-0.0295***	-0.0290	0.705***	0.532***
	[0.00202]	[0.00415]	[0.00583]	[0.0263]	[0.0342]	[0.0505]
Default - 1	-0.00947***	-0.0155***	-0.0139***	-0.0248	0.376***	0.244***
	[0.00189]	[0.00351]	[0.00441]	[0.0240]	[0.0337]	[0.0444]
Default - 2	-0.00657***	-0.00819***	-0.00642*	-0.0252	0.198***	0.0959**
	[0.00177]	[0.00309]	[0.00350]	[0.0202]	[0.0335]	[0.0414]
Default - 3	-0.00367**	-0.00493	-0.00291	-0.0220	0.123***	0.0635
	[0.00143]	[0.00334]	[0.00390]	[0.0153]	[0.0342]	[0.0414]
Default - 4	-0.00179*	-0.000156	-0.000972	-0.0154*	0.0830***	0.0363
	[0.00108]	[0.00352]	[0.00438]	[0.00907]	[0.0305]	[0.0358]
Constant	0.00995***	0.00839***	0.0310	0.318***	0.282***	-0.0129
	[0.00133]	[0.00300]	[0.0406]	[0.0155]	[0.0292]	[0.372]
Observations	19,661	3,109	1,846	20,966	3,584	1,874
R-squared	0.024	0.101	0.115	0.002	0.385	0.387
Number of firms	1,632	360	233	1,780	379	236
Controls	No	No	Yes	No	No	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 3. Extensive margin: Within-firm evolution of the supplier-client relationship as firms approach distress

The dependent variables are the number of suppliers (columns 1-3) and the logarithm of distance from supplier to client headquarters (columns 4-6). Independent variables are: Default (a dummy taking a one in the quarter of default zero otherwise), and Distress -k, k=1 to 4, which are four dummy variables taking a one during the k-th year before default, zero otherwise. Estimations with controls include log of assets, tangible assets to total assets, cash to total assets, leverage ratio, net worth, sales growth, Herfindahl index for sales concentration, market to book ratio, and net profit margin; and client to supplier size ratio, change in sales of supplier, market concentration and market share of the supplier. Estimations are done over the subsample of firms with information about suppliers, and fixed effects are defined at the client-supplier pair level. Estimations include up to 20 quarters of information before the default date. Distressed firms are matched to all non-distressed firms in the same industry, assigning to them the date of the default of the matched distressed firm. Standard errors are clustered at the firm level. ***, **, and * means statistically significant at the 1, 5, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Number of suppliers			Log (distance from suppliers to client headquarters)		
	No Distress	Distress	Distress	No Distress	Distress	Distress
Default quarter	0.829***	-5.396***	2.654*	0.0110	0.136	-0.259
	[0.0458]	[1.397]	[1.490]	[0.0142]	[0.158]	[0.300]
Default - 1	0.506***	-6.676***	-0.987	0.0177	0.0409	-0.260
	[0.0413]	[1.091]	[0.875]	[0.0133]	[0.158]	[0.198]
Default - 2	0.188***	-6.989***	-3.168***	0.0256**	-0.102	-0.423*
	[0.0381]	[0.866]	[0.748]	[0.0124]	[0.139]	[0.222]
Default - 3	0.00789	-5.742***	-3.796***	0.0208*	-0.205*	-0.357*
	[0.0343]	[0.545]	[0.687]	[0.0110]	[0.115]	[0.213]
Default - 4	-0.0123	-2.125***	-2.315***	0.0190**	-0.114	-0.147
	[0.0258]	[0.361]	[0.486]	[0.00794]	[0.0796]	[0.181]
Constant	8.639***	19.76***	-9.586	6.783***	6.401***	5.932***
	[0.0346]	[0.576]	[7.005]	[0.0118]	[0.118]	[1.483]
Observations	316,908	1,965	804	265,043	1,762	757
R-squared	0.829	0.908	0.966	0.379	0.498	0.594
Controls	No	No	Yes	No	No	Yes
Client FE	Yes	Yes	Yes	Yes	Yes	Yes

Figure 2. Cross-sectional trends in client-supplier relationship as firms approach default

This figure contains the cross-sectional point estimates and 95% confidence intervals for the yearly averages of the number of suppliers. Averages are calculated separately for distressed firms and the matched non-distressed firms in the same industry.

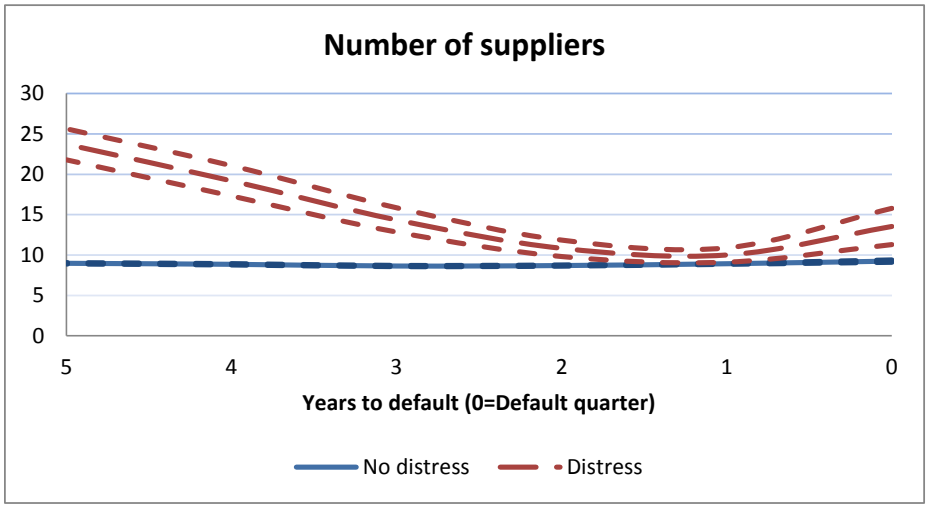


Table 4. Intensive margin: Within-firm evolution of sales and trade credit for distressed firms

The dependent variable is: the logarithm of the supplier's sales to the distressed client (columns 1 and 2), the logarithm of the supplier's sales to the distressed client as proportion of total supplier sales (columns 3 and 4), and the net increase in accounts payables to assets ratio (columns 5 and 6). Independent variables are: Default (a dummy taking a one in the quarter of default zero otherwise), Distress -k, k=1 to 4, which are four dummy variables taking a one during the k-th year before default, zero otherwise, Supplier stays (a dummy taking a one if the supplier is present 2 quarters before distress), and interactions of the time to default and Supplier stays. Estimations with controls include log of assets, tangible assets to total assets, cash to total assets, leverage ratio, net worth, sales growth, Herfindahl index for sales concentration, market to book ratio, and net profit margin; and client to supplier size ratio, change in sales of supplier, market concentration and market share of the supplier. Estimations are done over the subsample of distressed firms with information about suppliers, and fixed effects are defined at the client-supplier pair level. Estimations include up to 20 quarters of information before the default date. Standard errors are clustered at the firm level. ***, **, and * means statistically significant at the 1, 5, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	Log (supplier's sales to client)		Log (supplier's sales to client / total supplier sales)		Net issuance in accounts payable	
Default - 1	-0.215	-0.535**	-0.564***	-0.606**	-0.0823***	-0.124***
	[0.167]	[0.235]	[0.164]	[0.238]	[0.0171]	[0.0211]
Default - 2	-0.252*	-0.394*	-0.364**	-0.452**	-0.00655	-0.0218**
	[0.143]	[0.201]	[0.155]	[0.217]	[0.00410]	[0.00848]
Default - 3	-0.127	-0.296*	-0.273**	-0.386*	-0.00413	-0.0239***
	[0.0786]	[0.175]	[0.119]	[0.198]	[0.00266]	[0.00733]
Default - 4	0.0205	-0.00761	-0.0576	-0.0824	0.00116	-0.00582*
	[0.0531]	[0.109]	[0.0823]	[0.140]	[0.00218]	[0.00330]
Default quarter * Supplier stays	0.0343	-0.116	-0.284*	-0.192	-0.0445***	-0.0814***
	[0.106]	[0.299]	[0.151]	[0.304]	[0.00691]	[0.0169]
Default - 1 * Supplier stays	0.332*	0.453	0.330	0.440	0.0709***	0.0738***
	[0.197]	[0.295]	[0.209]	[0.298]	[0.0174]	[0.0213]
Default - 2 * Supplier stays	0.369**	0.330	0.261	0.321	0.0100**	0.00390
	[0.173]	[0.255]	[0.200]	[0.269]	[0.00490]	[0.00808]
Default - 3 * Supplier stays	0.226	0.232	0.238	0.294	0.00849**	0.00315
	[0.139]	[0.264]	[0.174]	[0.274]	[0.00379]	[0.00654]
Default - 4 * Supplier stays	0.0738	0.0939	0.0569	0.217	0.00182	-0.00204
	[0.0900]	[0.159]	[0.112]	[0.174]	[0.00305]	[0.00388]
Constant	3.757***	1.303	-2.519***	-4.790***	0.00336**	-0.295***
	[0.0500]	[1.207]	[0.0669]	[1.255]	[0.00138]	[0.0737]
Observations	1,737	697	1,697	697	1,686	798
R-squared	0.024	0.085	0.049	0.094	0.091	0.239
Controls	No	Yes	No	Yes	No	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of supplier-client pairs	246	153	242	153	205	172

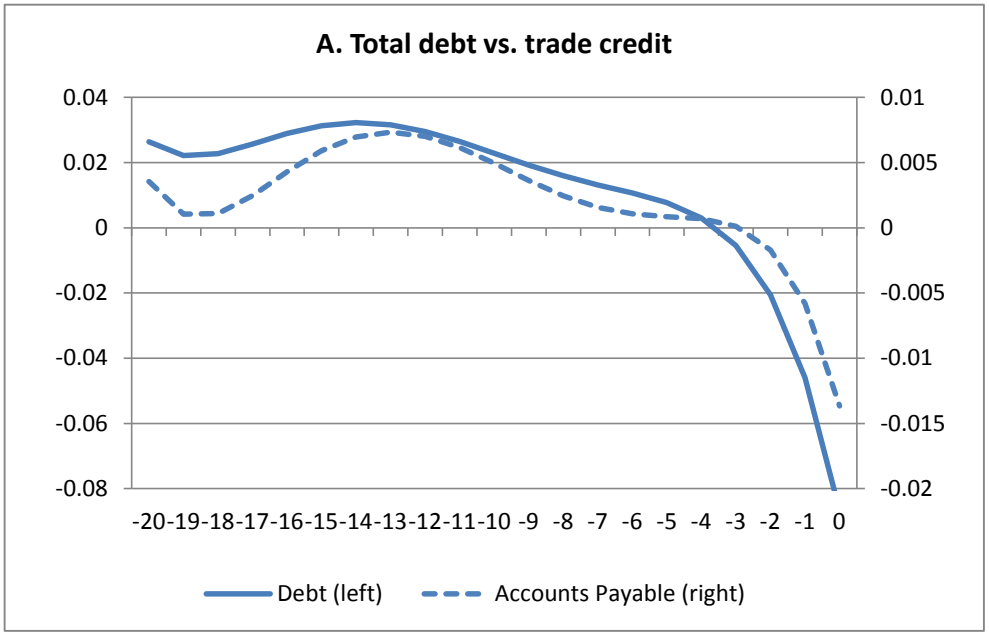
Table 5. Who stays?

The dependent variable is a dummy variable taking a one if the supplier stays with its customer at least 2 quarters previous to the default event, and zero if the supplier exits from the distressed relationship earlier. The sample for the estimation corresponds to all supplier-client pairs in which the client has a distress event. Regressions in columns 1-5 are cross-sectional, and all independent variables correspond to their average values over the pre-distress period. Regressions in columns 5-8 include client-time fixed effects. Coefficients are estimated using OLS. *, **, and *** represent significance at the 10, 5, and 1% levels, respectively. Heteroscedasticity-consistent standard errors are in brackets (columns 1-4). Standard errors are clustered at the firm level (columns 5-8).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Client mkt concentrated (0,1)	0.170**				0.0790				
	[0.0764]				[0.0819]				
Important client (0,1)		0.135*			0.135*	0.179***			0.184***
		[0.0726]			[0.0771]	[0.0468]			[0.0505]
Distance ('000 km)			-0.0425*		-0.0334		-0.00670		
			[0.0218]		[0.0231]		[0.0215]		
Differentiated goods (0,1)				0.0405				0.250***	0.302***
				[0.0668]				[0.0637]	[0.0653]
Supplier log of assets	0.0489**	0.0599***	0.0384**	0.0281	0.0643***	0.0479*	0.0281	0.0174	0.0371*
	[0.0201]	[0.0199]	[0.0163]	[0.0178]	[0.0206]	[0.0265]	[0.0300]	[0.0246]	[0.0193]
Client log of assets	-0.0134	0.00213	-0.0383**	-0.0221	-0.0155				
	[0.0189]	[0.0176]	[0.0160]	[0.0168]	[0.0192]				
Constant	0.0104	-0.173	0.662***	0.477***	-0.0472	0.111	0.413**	0.308**	-0.0307
	[0.174]	[0.180]	[0.175]	[0.175]	[0.204]	[0.144]	[0.187]	[0.151]	[0.0914]
Observations (pairs)	152	151	262	229	139	1,408	1,718	1,590	1,195
R-squared	0.070	0.073	0.040	0.015	0.099	0.421	0.456	0.455	0.448
Client-time FE	No	No	No	No	No	Yes	Yes	Yes	Yes

Figure A.1. Who exits distressed relationships earlier?

In this figure, we compare the evolution of debt issuance and accounts payable of distressed firms as a function of the time to default, as estimated through the polybomial of order M which best fits the data (see Equation 2 in the Appendix). The sample corresponds to distressed firms in our base data set. To construct the graphs, we set the values of all control variables except the time to default equal to its average value over the estimation sample.



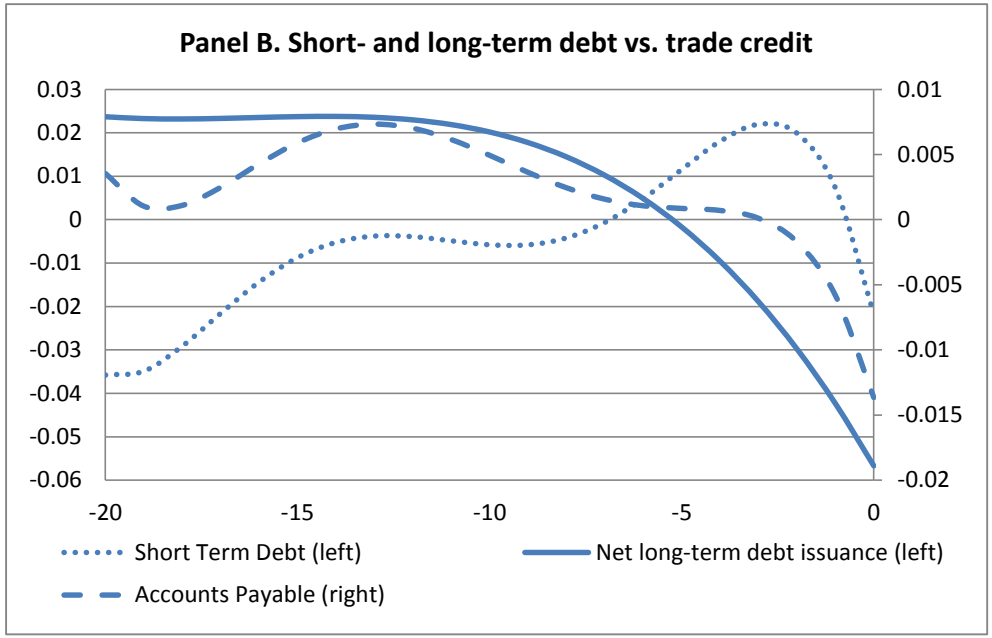


Table A. 1. Polynomials of debt issuance on time to default

This table reports the coefficients for the polynomial of order M that best fits the data according to Equation (2) in the text. The dependent variables are: net debt issuance (column 1), net increase in accounts payable (AP) (column 2), net short-term debt issuance (column 3), and net long-term debt issuance (column 4). Estimations are performed over our base sample. The lower part of the table contains (i) F-tests of joint significance of the coefficients (b1,..., bM) and (ii) whether coefficients b1, ..., bM are individually significant for all polynomial models of order M=1, 2,...,5 estimated for the same dependent variable as the one corresponding to the reported regressions.

	(1)	(2)	(3)	(4)
VARIABLES	Net debt issuance	Net increase in AP	Net short-term debt issuance	Net long-term debt issuance
t	0.0503***	0.0103***	0.0397***	0.0153***
	[0.00664]	[0.00263]	[0.00736]	[0.00215]
t^2	-0.0106***	-0.00278***	-0.0119***	-0.000958***
	[0.00202]	[0.000790]	[0.00211]	[0.000233]
t^3	0.00111***	0.000345***	0.00137***	1.97e-05***
	[0.000256]	[9.82e-05]	[0.000250]	[7.27e-06]
t^4	-5.41e-05***	-1.88e-05***	-6.84e-05***	
	[1.40e-05]	[5.33e-06]	[1.30e-05]	
t^5	9.76e-07***	3.66e-07***	1.23e-06***	
	[2.76e-07]	[1.05e-07]	[2.45e-07]	
Log of assets	0.0308***	0.00912***	0.0158***	0.0149***
	[0.00453]	[0.00182]	[0.00288]	[0.00297]
Debt / assets	0.124***	0.000437	0.0952***	0.0276***
	[0.0130]	[0.00323]	[0.0101]	[0.00775]
PPE / assets	-0.0895***	-0.0230***	-0.00899	-0.0622***
	[0.0269]	[0.00841]	[0.0161]	[0.0200]
Market share	-0.151**	-0.0281	0.0220	-0.171***
	[0.0704]	[0.0231]	[0.0482]	[0.0447]
Q	-0.00184	0.00151**	-0.000999	-0.000200
	[0.00123]	[0.000673]	[0.000913]	[0.000609]
Change in sales	0.0268***	0.0177***	0.00827**	0.0175***
	[0.00535]	[0.00294]	[0.00323]	[0.00366]
Constant	-0.277***	-0.0597***	-0.150***	-0.125***
	[0.0273]	[0.0114]	[0.0175]	[0.0191]
Observations	9,354	9,457	9,370	9,473
R-squared	0.107	0.045	0.062	0.055
Number of groupid	653	661	653	663
F-tests for joint test of hypothesis Ho: (b1=0, …, bM=0) for fitted model of order M				
T-stat order 1	0.00436***	0.000789***	0.000558***	0.00317***
std. error	[0.000321]	[9.61e-05]	[0.000196]	[0.000230]
M=1	184.486	67.407	8.105	189.960
p-value	0.000	0.000	0.000	0.000
M=2	105.421	39.222	9.512	113.212
p-value	0.000	0.000	0.000	0.000
M=3	38.338	7.846	8.369	**44.023**
p-value	0.000	0.000	0.000	**0.000**
M=4	16.761	1.126	15.301	4.926
p-value	0.000	0.325	0.000	0.008
M=5	**12.472**	**6.193**	**18.124**	0.508
p-value	**0.000**	**0.002**	**0.000**	0.602
Are all coefficients (b1, …, bM) individually significant for the fitted model of order M?				
M=1	Yes	Yes	Yes	Yes
M=2	Yes	Yes	No	Yes
M=3	Yes	No	No	**Yes**
M=4	Yes	No	Yes	No
M=5	**Yes**	**Yes**	**Yes**	No