Trade credit and bank credit: Evidence from recent financial crises

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[a]

Abstract

This paper studies the effect of financial crises on trade credit for a sample of 890 firms in six emerging economies. Although the provision of trade credit increases right after a crisis, it contracts in the following months and years. Firms that are financially more vulnerable to crises extend less trade credit to their customers. We argue that the decline in aggregate trade credit ratios is driven by the reduction in the supply of trade credit that follows a bank credit crunch, consistent with the ''redistribution view'' of trade credit provision, whereby bank credit is redistributed via trade credit from financially stronger firms to weaker firms.

JEL classification: G20; G32

Keywords: Emerging markets; Financial crises; Trade credit

[$]This paper is part of the dissertation of Lorenzo Preve (University of Texas, Austin) and Virginia SarriaAllende (Columbia Business School). We thank Andres Almazan, Charles Calomiris, Raymond Fisman, Jay Hartzell, Charles Himmelberg, Laurie Simon Hodrick, Patrick Honohan, Ross Jennings, Andrei Kirilenko, Pamela Moulton, Bob Parrino, Mitchell Petersen, Francisco Perez Gonzalez, Sheridan Titman, Roberto Wessels, participants at the University of Texas seminar and the World Bank seminar, and an anonymous referee for helpful comments and suggestions. We thank Leora Klapper for sharing the foreign debt data. This paper's findings, interpretations, and conclusions are entirely those of the authors and do not necessarily represent the views of the World Bank, its Executive Directors, or the countries they represent.

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1. Introduction

The emerging markets financial crises of the 1990s present extreme cases of the collapse of institutional financing. Consequently, they provide researchers an opportunity to study the role of alternative sources of financing during periods of severe monetary contraction. Previous evidence from non-crisis settings suggests that trade credit can play an important role by compensating for unavailable bank credit.[1] In this paper, we study the use of trade credit during financial crises to examine the role played by trade credit as a last resort for funding under more extreme circumstances.

[1] See, for example, Petersen and Rajan (1997), Nilsen (2002), Fisman and Love (2003), and Wilner (2000).

In particular, we study the effects of the 1997 Asian crisis on firms operating in Indonesia, South Korea, Malaysia, the Philippines, and Thailand, and the effects of the 1994 peso devaluation on Mexican firms. We find an increase in the amount of trade credit provided and received immediately after a crisis. Surprisingly, however, the amount of credit provided (as opposed to received) collapses in the aftermath of the crisis, and continues to contract for several years. Our sample contains mostly large, publicly traded companies, which are likely to be the most resilient to crisis events. This makes the postcrisis decline in trade credit provision even more puzzling.

The interpretation of these aggregate results presents a familiar identification problem: the decrease in trade credit after the crisis could be due to either the unwillingness of customers to take on more credit (demand effect) or the inability of suppliers to provide such credit (supply effect). Prior research (e.g., Petersen and Rajan, 1997) generally presupposes that firms will take any credit offered, thereby assuming away the problem. Our unique identification strategy relies on pre-crisis indicators of a firm's vulnerability to financial crises together with exogenous crisis events. Firms with more vulnerable financial positions are more likely to be (negatively) affected by crisis events, and are thus more likely to reduce their supply of credit to customers and increase their use of credit from suppliers. We use a firm's reliance on short-term debt as our main indicator of financial vulnerability to a crisis (due to increased interest rates and difficulties in rolling over debt). We find that firms with high short-term debt reduce the provision of trade credit relatively more in response to an aggregate contraction in bank credit, consistent with a reduction in the supply of trade credit caused by the crisis. We find similar results using alternative indicators of a firm's financial health, such as foreign currency denominated debt, cash stocks, and cash flows.

The temporary increase in trade credit at the peak of a financial crisis is likely to be caused by the accumulation of unpaid credit until suppliers take write-downs (or buyers resume payments). We conclude that while trade credit terms can be extended temporarily in the short-run, such terms can not fully compensate for the long-term contraction in bank credit that stems from a financial crisis.

On the surface, our results seem to contradict previous findings that when bank credit is unavailable, trade credit is often used as a substitute (e.g., Petersen and Rajan, 1997; Nilsen, 2002; Fisman and Love, 2003; and Wilner, 2000). Based on this literature, one might expect that during a financial crisis, when bank credit shrinks, trade credit should become relatively more important as a source of finance and therefore the use of trade credit (scaled by economic activity) should increase.

This apparent contradiction is resolved once one takes into account the redistribution view of trade credit, and adapts it to the extreme scenarios imposed by financial crises. The redistribution view of Meltzer (1960), Petersen and Rajan (1997), and Nilsen (2002), among others, posits that firms with better access to capital will redistribute the credit they receive to less advantaged firms via trade credit. However, for redistribution to take place, some firms first need to be able to raise external finance to pass on to less privileged firms.[2]During a financial crisis, alternative sources of financing become scarce as stock markets crash and foreign lenders and investors pull out their

[2] For example, during monetary contractions in the U.S., large firms increase the issuance of commercial paper (Calomiris, Himmelberg, and Wachtel, 1995) and accelerate bank credit growth while small firms reduce these instruments (Gertler and Gilchrist, 1994). Such access to alternative sources of finance in the U.S. is likely what explains the aggregate increase in trade credit (during monetary contractions) that Nilsen (2002) observes.

money. That is, as all the potential sources of funds dry up, there may be nothing left to redistribute through trade credit.

In sum, our findings expand the traditional setting of the redistribution view: redistribution shuts down when all sources of finance dry up, as is the case during a financial crisis. Thus, the credit crunch that affects financial lenders also affects nonfinancial lenders (i.e., trade credit). Consistent with this argument, we also find that countries that experience a sharper decline in bank credit also experience a sharper decline in trade credit.

The remainder of the paper is as follows. Section 2 describes our data and presents basic descriptive analysis. In Section 3 we discuss our empirical strategy. In Section 4 we present our results and in Section 5 we conclude.

2. Data

2.1. Sample

We study two of the four major financial crises that occurred during the 1990s, namely the Mexican devaluation of late 1994 and the Southeast Asia currency crisis of mid-1997, which affected Indonesia, Korea, Malaysia, the Philippines, and Thailand. We obtain our data from the Worldscope database, which contains observations on publicly traded firms around the world and represents about 95% of the world's market value. Since this database focuses largely on those firms for which there is significant international investor interest, the sample represents the largest firms in each country. Our study excludes all financial firms.

Periods of financial crisis are usually characterized by high rates of liquidation and consolidation, which creates an unbalanced sample of firms (Worldscope immediately delists all firms that undergo any type of reorganization). To avoid an attrition bias, we present our results using this unbalanced sample. However, all our results hold when we run estimations on two alternative balanced samples, suggesting that the attrition bias is empirically unimportant in this setting.[3]

2.2. Crisis timing

Table 1, Panel A reports both the time period associated with the two crises we study and the number of firms per country (as of the crisis year) for our sample of 890 firms. To account for the time before and after the crisis, we create a timeline variable that equals zero in the crisis year and takes the values –1, –2, –3 and 1, 2, 3 for the three pre- and postcrisis years, respectively. We define the crisis year for each firm as the fiscal year ending within the 12-month interval beginning with the crisis. Thus, for the Asian countries hit by the crisis in July 1997, the crisis year is defined as 1997 for those firms with fiscal year-ends between August 1997 and December 1997 and as 1998 for those with fiscal year-ends between January 1998 and July 1998.

[3] An attrition bias would arise if failing firms were to have different trade credit policies than surviving firms. It is plausible that firms that are unable to obtain credit from their suppliers or extend credit to their customers (i.e., those that have lower trade credit usage) are more likely to fail. Therefore, excluding these firms from our analysis could bias the results towards finding an increase in trade credit in the post-crisis period. To test for this possibility, we create two balanced samples. The first sample, ''balanced 5,'' contains all firms that are present in the database for at least the two years before and after the crisis (therefore covering the five years centered on the

2.3. Dependent variables

Our two main variables of interest are accounts payable and accounts receivable, which show the amount of trade credit that firms obtain from suppliers and provide to customers, respectively. We scale these trade credit variables using sales (for receivables) and cost of goods sold (for payables). These ratios capture the importance of trade credit in the financing of economic activity. Using ratios scaled by flow variables controls for declines in economic activity (e.g., sales) that are commonly associated with crises.

There are two ways in which these ratios can be interpreted. If trade credit were extended for the entire year, the ratio of receivables to sales would indicate the percentage of sales that is purchased on credit. However, as trade credit usually has a much shorter maturity, the alternative interpretation of this ratio is the number of days customers take to repay their credit (assuming all customers receive 100% credit). In reality, the receivables-to-sales ratio is likely to capture both the percent of goods sold on credit and the time it takes for credit to be repaid. Following tradition, however, we multiply these ratios by 360 and interpret them in terms of the number of days credit is extended and received, keeping the above caveat in mind.

We also study net credit, defined as the difference between receivables and payables, scaled by sales. Firms that obtain more credit from their suppliers are likely to extend more credit to their customers. In this sense, net credit reflects the relative willingness of firms to extend trade credit, net of the credit that the firms receive themselves. To summarize, we use the following three dependent variables:

TRECTOS: Trade Receivables/Total Sales TPAYTOC:
Trade Payables/Cost of Goods Sold
NTCS: (Trade Receivables – Trade Payables)/Total Sales.

To ensure the robustness of our results, we examine the distribution of our key variables and remove outliers. We begin by removing all observations that appear to be misreported (such as negative numbers for trade credit or assets). Further, for our trade credit ratios, we eliminate all values that imply trade credit of longer than one year, eliminating

(footnote continued) crisis event). The second sample, ''balanced 7,'' contains firms that are in the data set for at least the seven years centered on the crisis event. Our results, available upon request, are qualitatively similar when we use either of the two balanced samples.

Table 1
Financial Crises: descriptive statistics
Panel A. Number of observations by country. This table presents the number of observations by country, based on the number of non-missing values of the variable Trectos (computed as trade receivables/net sales), counted at the crisis time. The second column presents the crisis date for each country.

Country	Number of observations	Crisis date
Indonesia	102	Jul-97
Korea	236	Oct-97
Malaysia	261	Jul-97
Me´ xico	59	Dec-94
Philippines	54	Jul-97
Thailand	178	Jul-97
Total	890	

Panel B. Summary statistics. Trectos is measured as trade receivables/net sales, Tpaytoc is trade payables/cost of goods sold, and Ntcs is net trade credit (i.e., receivables minus payables)/net sales. Cfw is operating cash flow to assets, Growth is computed as lagged growth of sales, Cashta is cash/assets, Exchrgr is the country's devaluation of the currency in the last year, and Stdtoa is short term debt/total assets. The sample is the unbalanced panel of firms three years before and after each crisis.

Variable	N. obs.	Mean	Min	Median	Max	St. dev.
Dependent variables Trectos	5552	94.03	0.00	80.86	290.67	60.68
Tpaytoc	5554	57.54	0.00	49.59	210.00	38.97
Ntcs	5325	51.42	114.15	41.43	275.75	56.88
Control variables						
Cfw	5651	0.05	0.58	0.06	0.31	0.11
Growth	5255	0.05	0.90	0.05	0.90	0.26
Cashta	5868	0.10	0.00	0.06	0.94	0.11
Exchrgr	5441	0.10	0.24	0.03	1.24	0.23
Stdtoa	5755	0.21	0.00	0.17	0.99	0.18

Panel C. ANOVA analysis. This table reports the difference in means between the two periods and the corresponding pvalues (computed using the Bonferroni-adjusted significance levels). Trectos is computed as trade receivables/net sales, Tpaytoc is trade payables/cost of goods sold, and Ntcs is net trade credit/net sales. The sample is the unbalanced panel of firms three years before and after each crisis.

Variable	Crisis vs. pre-crisis	Post-crisis vs. pre-crisis
Trectos	5.2930	13.2226
	0.080	0.000
Tpaytoc	6.9031	0.5190
	0.000	1.000
Ntcs	0.0496	14.93
	1.000	0.000

approximately 2–3% of the observations in the top tail of the distribution. Finally, we remove observations with extreme values for our control variables (1%-tails of the distribution of sales growth, cash stock, and cash flow ratios).[4] Table 1, Panel B presents the summary statistics.

2.4. Descriptive analysis

Fig. 1 presents the medians of the trade credit ratios and the aggregate bank credit figures around the crisis event dates. We find that all trade credit ratios exhibit very similar patterns,

[4] To preserve our sample size, we set outlier observations to missing instead of dropping them, As a result, the number of actual observations we use differs somewhat from model to model.

namely, a slight increase in the crisis year followed by sharp declines subsequent to the crisis period. The decline is more pronounced for receivables, however, which go from 90 days at the height of the crisis to 66 days two years after the crisis, a decrease of 24 days or 26%. Payables exhibit a decline over the same period of only about ten days, or 15%. Furthermore, while trade payables start to increase in the second year after the crisis, almost fully recovering in the third year, receivables stay low for the three years following a crisis.[5] Finally, bank credit growth exhibits a pattern very similar to that of the trade credit ratios – i.e., it declines in the 2 years after a crisis, falling from an average growth rate of about 10% year to a negative growth rate of 5%.

Table 1, Panel C presents tests for the statistical significance of the differences in the trade credit figures between both the crisis and post-crisis periods relative to the pre-crisis period. The outcome is consistent with our graphical analysis: both payables and receivables increase significantly in the crisis year, but only trade receivables and net credit show a persistent decline in subsequent periods relative to the pre-crisis period. In the next section we present a more formal discussion of the empirical models that we use to study these patterns.

3. Empirical strategy

To study the effects of a financial crisis on trade credit, we employ a standard panel-data approach utilizing a firm fixed effects model. The fixed effects capture the unobserved heterogeneity in the firm-specific (i.e., time-invariant) levels of trade credit and allow us to isolate both crisis and post-crisis effects from pre-crisis behavior.

3.1. Aggregate behavior

Our first test studies the aggregate behavior of firms during and after a crisis. To implement this test, we define dummy variables, CRISIS and POST, for the crisis and post-crisis years respectively. Combined with the fixed effects, these dummies capture changes in trade credit relative to several years of pre-crisis data.

[5] We also plot ratios scaled by assets on the same graphs, for comparison. We refer to these modified variables as trectoa, tpaytoa, and ntca for receivables, payables, and net trade credit, respectively. When we graph the data separately for each country, we find that most countries follow the same aggregate patterns. The most uniform behavior obtains for receivables and net credit, while payables seems to exhibit more variation across countries. Reproducing these graphs for mean ratios generates identical patterns.

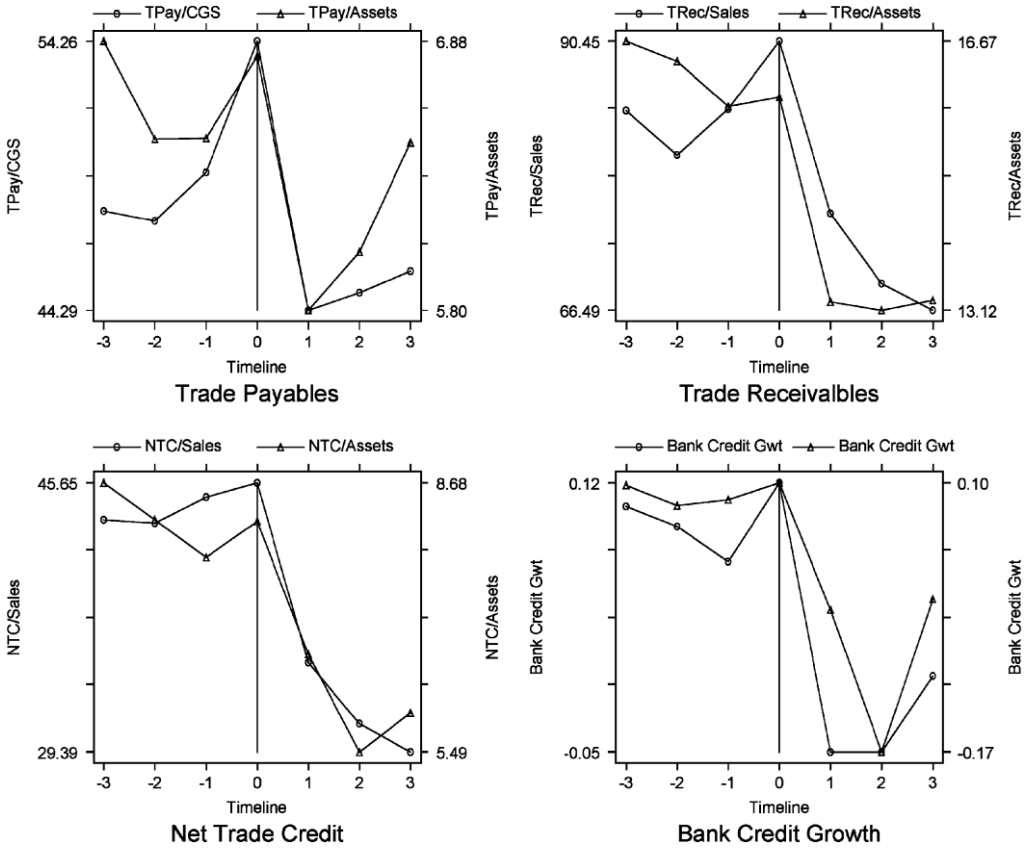

Fig. 1. Graphical analysis of trade credit and bank credit patterns.

The model we use is as follows:

$TC_{it} = a_i + b_1 CRISIS_{ct} + b_2 POST_{ct} + b_3 X_{it} + e_{it}$, (1) where TC is one of the three trade credit measures described earlier, X is a vector of firm and country time-specific control variables, a is a firm fixed effect, and e is an error term.

The crisis and post-crisis dummies give the difference between the crisis and post-crisis trade credit ratios, respectively, and the average of the pre-crisis years. In the reported regressions we use three post-crisis dummies: POST1, POST2, and POST3, where each dummy equals one for the corresponding year and zero otherwise.

To make sure our results are robust to any possible intertemporal correlation among the firms in each country–year period, we estimate the model with ‘‘clustering’’ defined at the country–year level (see Bertrand et al., 2004).

Causal factors that are either time-invariant (e.g., industry) or slowly changing (e.g., size) should be captured by the fixed effects. To control for factors that vary significantly over time,

we use several control variables (those of vector X in model 1), as suggested by the trade credit literature (e.g., Petersen and Rajan, 1997; and Calomiris, Himmelberg, and Wachtel, 1995). Specifically, we use the ratio of cash flow to total assets, the ratio of cash balances to total assets (measured at the beginning of the period), and the firm-level sales growth rate in the previous year. Finally, we control for the depreciation of the exchange rate to capture country-time differences in the magnitude of the crisis and recovery. Summary statistics for these variables are reported in Table 1, Panel B.

3.2. Heterogeneous firm responses

To understand what is driving the aggregate results, i.e., to identify supply or demand effects, we analyze firms' heterogeneous responses to crisis events. As noted earlier, our identification strategy relies on pre-crisis indicators of a firm's vulnerability combined with exogenous crisis events. We argue that firms with a more vulnerable financial position are more likely to be (negatively) affected by a crisis and, in turn, are more likely to cut their supply of credit to customers and increase their use of credit from suppliers. Evidence in support of this argument would suggest that a contraction in aggregate credit provision is due to the presence of a net supply effect.

We use several indicators of a firm's vulnerability to a crisis. First, we use the ratio of shortterm debt to assets. Firms with a high proportion of short-term debt are more likely to be disadvantaged by a crisis because they will need to roll over their debt at a time when it is either impossible or extremely costly to do so. As a second measure of vulnerability, we consider a firm's short-term foreign currency denominated debt. This measure is especially relevant given the large currency devaluations that the crises we study have imposed on their respective countries.

Finally, we use standard proxies for the liquidity position of a firm, namely the firm's cash flow and cash stock, both relative to the firm's assets. We conjecture that firms with a larger precrisis stock of cash holdings (i.e., liquidity) as well as those with a greater cash flow generating capacity can fall back on these cushions during crisis events. Therefore, these firms are likely to be in a better financial position to provide trade credit to their customers (as well as avoid making use of expensive supplier financing) during crises.

To study differences in firms' responses to a crisis, we use the interaction of pre-crisis financing variables with crisis and post-crisis dummies. We use the following extension of the model in Eq. (1):

$$TC_{it} \text{¼ } a_i \text{ þ} b_1 \text{ CRISIS}_{ct} \text{ þ} b_2 \text{ POST}_{ct} \text{ þ} b_3 \text{ FIN}_{i\text{ð}1\text{Þ}} \text{ CRISIS}_{ct} \text{ þ} b_4 \text{ FIN}_{i\text{ð}1\text{Þ}} \text{ POST}_{ct} \text{ þ } X_{it} \text{ þ}_{it}, \quad \text{ð2Þ}$$

where $FIN_{i(1)}$ represents one of the above-described indicators of financial soundness. Since FIN is not time-varying (it is measured during the pre-crisis period), the level of FIN is subsumed into the fixed effects.

In model 2, the effect of a crisis on trade credit depends on the level of the financial indicator, FIN. For firms with FIN equal to zero, the difference in the crisis and post-crisis trade credit ratios (relative to the pre-crisis average) is given by b_1 and b_2, respectively, as in model 1. However, the

effect of a crisis on TC varies for firms with different levels of FIN. For example, for firms with a financial indicator equal to F, the difference in trade credit during the crisis (relative to pre-crisis levels) is given by $b_1 þb_3$ F.

3.3. Heterogeneous country-level response to crisis

Our final test explores variation in bank credit growth across the years and countries in our sample. To test separately the effect of bank credit growth on trade credit behavior before, during, and after the crisis, we use the following model:

$$TC_{it} ¼ a_i þb_1 \ CRISIS_{ct} þb_2 \ POST_{ct} þb_3 \ CREDITGR_{ct} þb_4 \ CREDITGR_{ct} \ CRISIS_{ct} þb_5 \ CREDITGR_{ct} \ POST_{ct} þ X_{it} þ_{it}, \quad ð3Þ$$

where CREDITGR is the country–year growth rate in ratio of the private credit to GDP (obtained from International Financial Statistics, published by the IMF). The coefficients b_3, b_4, and b_5 give the reaction of trade credit to bank credit growth during the pre-crisis, crisis, and post-crisis periods, respectively. Positive coefficients on b_4 and b_5 would suggest that a decrease in bank credit during either the crisis or post-crisis years leads to a decrease in the amount of trade credit provided and/or accepted by firms in our sample, consistent with the redistribution story.

4. Results

4.1. Aggregate patterns

Table 2 presents our basic results. The coefficients on the crisis and post-crisis dummies show the difference in trade credit between these and pre-crisis periods. We observe the same pattern that emerges in the graphical analysis. In particular, accounts receivable increases immediately after the crisis and then drops sharply in the post-crisis period. Accounts payable, however, does not exhibit a significant decline (relative to pre-crisis figures) after increasing at the peak of the crisis. In terms of magnitudes, we find that during the crisis year, both payables and receivables increase by about one week. During the post-crisis years, however, receivables fall by about ten days relative to pre-crisis figures in the second year, and by about 14 days in the third year (in the first year, the decline is not statistically significant). Given that the average maturity of trade credit in our data is approximately 90 days (for receivables), this magnitude is not immaterial.

Since we focus only on the largest publicly traded companies, our results might not be representative of the whole population. Nevertheless, given that the firms in our sample are the best positioned to withstand a crisis (by virtue of their being the largest publicly traded firms), our sample is, if anything, biased against finding a significantly negative crisis effect.

A plausible explanation for the short-term increase in trade credit during the crisis year is straightforward: after a crisis hits, buyers stop making payments to suppliers and credit accumulates until either the suppliers take the write-downs or the buyers resume repayment. In

other words, in the chaos of a crisis, everybody stops paying back their trade credit debt, at least temporarily.[6] Indeed, Cun˜ at (2002) argues that the ability to delay

Table 2
Trade credit in aggregate

The dependent variables are the trade credit measures: Trectos is trade receivables/net sales, Tpaytoc is trade payables/cost of goods sold, and Ntcs is net trade credit (i.e., receivables minus payables)/net sales. Crisis is a dummy for the crisis year; Post1, Post2, and Post3 are dummies for respective post-crisis years. Cfw is operating cash flow to assets, Growth is lagged growth of sales, Cashta is cash/assets measured at the beginning of the year, and Exchrgr is the rate of currency devaluation. The models are estimated with firm fixed effects (see model 1 in the paper) using the unbalanced sample. The standard errors are obtained using clustering on country and time as explained in the paper. ***, **, and * represent coefficients significant at the 1%, 5%, and 10% level. Absolute values of t-stats are in brackets.

	(1) Trectos	(2) Tpaytoc	(3) Ntcs	(4) Trectos	(5) Tpaytoc	(6) Ntcs
Crisis	7.60**	7.02**	2.09	7.96**	7.60**	2.23
	[2.05]	[2.12]	[0.82]	[2.38]	[2.34]	[0.84]
Post1	3.18	0.19	4.34**	3.80	0.99	6.31*
	[1.19]	[0.11]	[2.24]	[0.96]	[0.55]	[1.95]
Post2	9.74**	0.46	11.07***	9.93**	1.15	9.58**
	[2.39]	[0.26]	[2.90]	[2.56]	[0.64]	[2.52]
Post3	14.02***	1.22	15.14***	14.31***	1.09	14.72***
	[3.36]	[0.26]	[5.10]	[3.87]	[0.26]	[5.12]
Cfw				2.74	9.18	18.08**
				[0.27]	[1.59]	[2.10]
Growth				5.19	6.71***	0.18
				[1.63]	[3.21]	[0.06]
Cashta				4.36	3.26	4.36
				[0.49]	[0.36]	[0.33]
Exchrgr				1.87	7.19	7.87*
				[0.31]	[1.57]	[1.85]
Constant	96.62***	56.14***	55.39***	95.43***	56.66***	52.80***

[6] Because trade credit maturity is usually much shorter than one year, the temporary spike in both ratios is not simply caused by a mechanical relation that arises from a contraction in the scaling factor (i.e., sales or cost of goods sold). To

	[67.15]	[69.06]	[43.39]	[49.28]	[48.21]	[24.92]
Observations	5552	5554	5325	4256	4244	4091
R-squared	0.74	0.63	0.72	0.79	0.69	0.76

see this, suppose that a crisis occurs several months before the end of the fiscal year and that the maturity of receivables is less than one year. In this case, the mechanical relation would actually run in reverse—if accounts receivable declines by as much as sales, the ratio of receivables to sales would go down because the

repayment on trade credit in the case of temporary illiquidity is likely to be among the reasons for the high costs of trade credit.

As we noted earlier, there are two alternative explanations for the patterns we observe in postcrisis years. On the one hand, a decline in the provision of trade credit could be the result of a supply effect, i.e., firms that suffer from a lack of access to bank financing reduce the supply of credit they are willing to extend to their customers. On the other hand, this same pattern could be consistent with a demand-side story, i.e., customers of these firms become less willing to accept more credit.

We focus our efforts on trying to distinguish among potential causes for the decline in trade credit after the immediate crisis period, a decline that is both more prolonged and harder to explain.

(footnote continued) numerator would reflect a low post-crisis level of receivables (associated with a low post-crisis level of sales), while the

denominator would reflect the entire year of sales (i.e., high pre-crisis level and low post-crisis level).

4.2. Heterogeneous firm responses To understand the aggregate patterns we find, we explore firms' heterogeneous responses to a crisis. More specifically, we study a firm's trade credit policy as a function of its relative vulnerability to financial crises.

As a preliminary analysis, we first test whether our measures of vulnerability are associated with weaker financial performance during the crisis. We use simple crosssectional regressions with dependent variables defined as growth or performance over the crisis period (i.e., from year 1 to year +2, where 0 is the crisis year). We find that during a crisis, firms with more short-term debt grow less and realize lower operating performance, whereas firms with more liquidity grow more and realize better operating performance. These results (available on request) support our identification strategy, which relies on these particular measures of vulnerability to financial crisis.

4.2.1. Short-term debt

As suggested earlier, firms that enter a crisis with a high proportion of short-term debt are likely to be particularly disadvantaged by the related credit crunch because of the increased costs of short-term debt and the resulting difficulties in rolling it over.

In Table 3 we estimate model 2 using pre-crisis ratios of short-term debt to assets as an indicator of vulnerability. The pre-crisis level of short-term debt is subsumed by the fixed effects (because it is not time-varying) and consequently, we can only observe the differential responses to crisis events. We find that firms with high pre-crisis levels of shortterm debt decrease their provision

of trade credit during and after crises, and increase their reliance on credit from suppliers. The coefficients on the interaction terms are negative and significant for the ratio of trade receivables to sales, with or without the additional set of controls. In the case of trade payables, we find positive and significant coefficients in the Crisis and Post1 interaction terms (Column 5).

To infer the economic magnitude of these results we use Column 4 in Table 3. We find that a firm at the 75th percentile of the distribution (with a ratio of short-term debt to assets of 0.3) decreases its trade credit provision in the second year after the crisis by about 15 more days than a firm placed at the 25th percentile (with a ratio of short-term debt to assets equal to 0.07).[7] Interestingly, firms with no short-term debt (which constitute about 4% of our sample) actually increase their trade credit provision after the crisis (as indicated by the positive coefficients on the crisis and post-crisis dummies). Thus, we see that the observed post-crisis decline in aggregate trade credit is mostly attributed to firms with some pre-crisis short-term debt, and the more shortterm debt a firm has, the larger is the cut in its trade credit provision.[8]

We also experiment with an additional measure of vulnerability, namely a firm's reliance on short-term foreign debt. We obtain data on short-term foreign debt from Allayannis, Brown, and Klapper (2003) and find that firms with greater pre-crisis use of foreign short-

Table 3

Trade credit and short-term debt

The dependent variables are the trade credit measures (see Table 2 for variable definitions). Stdtoa1 is the firmlevel ratio of short-term debt to assets computed one year before the crisis. This table shows the interactions of Stdtoa with the Crisis, Post1, Post2, and Post3 dummies. The models are estimated with firm fixed effects (see model 2 in the paper), using the unbalanced sample. The standard errors are obtained using clustering on country and time as explained in the paper. ***, **, and * represent coefficients significant at the 1%, 5%, and 10% level. Absolute values of robust t-stats are in brackets.

(1)	(2)	(3)	(4)	(5)	(6)	
	Trectos		Tpaytoc	Ntcs	Trectos	Tpaytoc	Ntcs
Crisis	11.23***	4.33	7.66**	15.46***	4.19	13.65***
	[2.83]	[1.16]	[2.24]	[3.60]	[1.16]	[3.73]
Post1	8.54***	1.88	7.80***	8.67*	3.64	8.55**
	[2.58]	[0.74]	[2.84]	[1.75]	[1.29]	[2.37]
Post2	2.61		0.74	3.83	3.58	3.28	7.56
	[0.52]		[0.27]	[0.93]	[0.66]	[1.25]	[1.64]
Post3	0.29		6.98	3.33	0.04	3.28	0.60
	[0.06]		[1.14]	[0.84]	[0.01]	[0.55]	[0.17]
CrisisStdtoa1	17.01*		13.70***	26.96***	33.42***	16.26***	52.06***
	[1.82]		[2.77]	[3.25]	[2.82]	[3.07]	[5.48]
Post1Stdtoa1	60.12***		9.36	61.97***	57.90***	22.69***	68.63***

[7] For illustration, we took the coefficients on Post2 and Post2Stdtoa and obtained the magnitude for the 75th percentile from 3.58–66.050.3 ¼16.24, or about 16 days; a similar magnitude calculated for the 25th percentile is about one day.

[8] We also ran regressions with the contemporaneous short-term debt-to-assets ratio and found that firms with a higher percentage of short-term debt provide more credit to their customers during non-crisis times. Since contemporaneous debt levels are likely to be endogenous, we do not report these results here.

	[5.30]	[1.62]	[6.47]	[4.31]	[3.33]	[6.56]
Post2Stdtoa1	63.70***	0.77	77.04***	66.05***	9.42	83.02***
	[4.96]	[0.10]	[7.68]	[4.10]	[1.19]	[6.07]
Post3Stdtoa1	72.08***	29.34**	62.05***	70.49***	12.06	74.87***
	[3.94]	[2.23]	[4.19]	[3.86]	[1.01]	[4.80]
Cfw				3.89	8.21	19.30**
				[0.38]	[1.40]	[2.19]
Growth				5.79*	7.04***	0.82
				[1.75]	[3.30]	[0.28]
Cashta				4.23	2.74	3.76
				[0.48]	[0.30]	[0.29]
Exchrgr				0.77	6.99	6.64*
				[0.14]	[1.54]	[1.79]
Constant	96.45***	56.18***	55.19***	94.60***	56.88***	51.84***
	[77.49]	[69.29]	[50.38]	[55.53]	[45.60]	[28.92]
Observations	5385	5377	5168	4183	4170	4021
R-squared	0.75	0.63	0.72	0.79	0.69	0.77

term financing extend significantly less trade credit to their customers during the three years after the peak of a crisis. Even though our sample of firms with foreign debt data is rather small (only 134 firms), the results are statistically significant and are available upon request.

Thus far, our results suggest that the disruption to the redistribution mechanism typically provided by trade credit arises from the special difficulties that a crisis inflicts upon the traditional suppliers of this type of credit, namely firms that carry a higher exposure to short-term borrowing.

A possible caveat is that pre-crisis short-term debt-to-assets ratios might not be exogenous, i.e., firms with high levels of short-term debt could be fundamentally different from those that do not rely so heavily on this source of financing. While our fixed effects methodology mitigates some of these concerns, other explanations are possible and could be explored by subsequent research.

4.2.2. Cash flows and liquidity

To test the robustness of our previous result, we use two other indicators of a firm's vulnerability to crises. Specifically, firms that enjoy a larger liquidity cushion (i.e., a larger cash stock or a greater cash flow generating capacity) are better able to support profitable commercial

operations (by extending more credit to their customers) and temporarily reduce reliance on credit from suppliers.

In Table 4 we estimate model 2 using the pre-crisis ratio of cash flow to net assets as an alternative indicator of a firm's financial position. The interaction terms are positive and highly significant for receivables, with or without the inclusion of additional control variables. Thus, firms with high pre-crisis cash flow generating capacity provide more

Table 4
Trade credit and cash flows

The dependent variables are the trade credit measures (see Table 2 for variable definitions). Cfw1 is the measure of cash flow to total assets computed for the year prior to the crisis. This table shows the interactions of Cfw1 with the Crisis, Post1, Post2, and Post3 dummies. The models are estimated with firm fixed effects (see model 2 in the paper) using an unbalanced sample. The standard errors are obtained using clustering on country and time as explained in the paper. ***, **, and *represent coefficients significant at the 1%, 5%, and 10% level. Absolute values of robust t-stats are in brackets.

	(1)	(2)	(3)	(4)	(5)	(6)
	Trectos	Tpaytoc	Ntcs	Trectos	Tpaytoc	Ntcs
Crisis	4.58	6.72**	2.31	5.45*	9.02***	3.43
	[1.25]	[2.15]	[1.01]	[1.75]	[3.04]	[1.46]
Post1	11.93***	0.04	13.47***	11.05***	2.36	15.06***
	[3.74]	[0.02]	[5.59]	[3.24]	[1.02]	[5.13]
Post2	21.24***	0.57	23.26***	22.94***	0.78	24.15***
	[6.33]	[0.27]	[7.86]	[6.61]	[0.35]	[7.52]
Post3	25.90***	4.09	24.66***	28.16***	3.25	26.96***
	[5.02]	[0.72]	[8.35]	[6.04]	[0.64]	[9.47]
CrisisCfw1	50.49**	2.05	67.59***	46.73*	22.17	83.28***
	[2.22]	[0.10]	[4.24]	[1.74]	[1.03]	[3.36]
Post1Cfw1	125.86***	1.07	129.95***	108.48***	23.73	129.72***
	[5.41]	[0.06]	[6.00]	[4.02]	[1.21]	[5.06]
Post2Cfw1	159.04***	14.36	163.42***	162.87***	6.58	179.00***
	[6.06]	[0.77]	[8.15]	[5.96]	[0.31]	[8.36]
Post3Cfw1	159.87***	72.23***	124.91***	172.52***	52.06	146.89***
	[4.60]	[2.16]	[6.05]	[4.99]	[1.64]	[7.18]
Growth				4.92	6.77***	0.65
				[1.54]	[2.93]	[0.21]

Cashta				2.39	2.31	3.22
				[0.25]	[0.26]	[0.24]
Exchrgr				0.94	5.16	3.79
				[0.15]	[1.25]	[0.92]
Constant	96.56***	56.39***	55.22***	95.98***	56.32***	54.19***
	[63.38]	[69.82]	[41.64]	[53.97]	[44.67]	[29.78]
Observations	5330	5326	5122	4291	4289	4122
R-squared	0.75	0.63	0.72	0.79	0.68	0.76

financing to their customers both during and after crises. Indeed, the magnitudes of the coefficients imply that firms with cash flow ratios below the 86th percentile (about 0.13 in the data) reduce the credit they provide to their customers after a crisis, while firms with cash flow ratios above the 86th percentile actually increase the post-crisis level of credit they provide. There is no evidence, however, that high cash flow firms make less use of trade credit during and after crises.

Table 5 presents a similar test, which includes the interaction of the crisis and post-crisis indicators with the pre-crisis cash-to-assets ratio. We observe that firms with higher precrisis cash-to-assets ratios extend more credit to their customers during crisis and postcrisis periods. We also find that firms with larger stocks of cash accept less credit from suppliers; this is only true, however, for 2 years following a crisis event.

Since we construct the interactions using pre-crisis cash flows and cash stocks, the results imply that firms that are less vulnerable at the outset of a crisis are less affected by the crisis

Table 5
Trade credit and cash stock

The dependent variables are the trade credit measures (see Table 2 for variable definitions). Cashta1 is the ratio of cash to assets computed at the pre-crisis time. This table shows the interaction of Cashta1 with the Crisis, Post1, Post2, and Post3 dummies. The models are estimated with firm-fixed effects (see model 2 in the paper) using an unbalanced sample. The standard errors are obtained using clustering on country and time as explained in the paper. ***, **, and *represent coefficients significant at the 1%, 5%, and 10% level. Absolute values of robust tstats are in brackets.

	(1)	(2)	(3)	(4)	(5)	(6)
Crisis	6.37*	7.16**	0.58	4.79*	7.81***	1.21
	[1.92]	[2.25]	[0.23]	[1.77]	[2.61]	[0.50]
Post1	5.86*	0.80	7.59***	5.99	2.68	10.14**
	[1.65]	[0.39]	[2.71]	[1.31]	[1.51]	[2.50]

Post2	14.20***	2.09	16.14***	13.85***	2.32	15.22***
	[3.58]	[0.90]	[4.03]	[3.59]	[1.32]	[3.66]
Post3	18.83***	1.51	19.73***	18.77***	2.51	20.59***
	[4.51]	[0.26]	[7.31]	[5.33]	[0.49]	[7.22]
CrisisCashta1	16.11	1.67	19.05**	37.63**	4.07	42.02**
	[1.24]	[0.15]	[2.20]	[2.02]	[0.28]	[2.44]
Post1Cashta1	28.29**	8.80	34.19**	27.21	21.34**	46.69**
	[2.09]	[1.29]	[2.51]	[1.51]	[2.20]	[2.51]
Post2Cashta1	45.64**	15.56*	50.61***	44.51**	39.71***	63.86***
	[2.41]	[1.68]	[2.59]	[2.01]	[4.06]	[2.87]
Post3Cashta1	47.84***	1.66	44.26***	49.60**	16.14	64.63***
	[2.92]	[0.14]	[2.69]	[2.31]	[1.34]	[2.81]
Cfw				4.11	9.02	20.29**
	Trectos	Tpaytoc	Ntcs	Trectos	Tpaytoc	Ntcs

				[0.40]	[1.63]	[2.27]
Growth				5.67*	7.00***	0.79
				[1.70]	[3.30]	[0.26]
Exchrgr				1.80	7.05	7.71*
				[0.30]	[1.60]	[1.82]
Constant	96.56***	56.19***	55.30***	95.43***	57.23***	52.64***
	[68.65]	[69.56]	[44.68]	[60.37]	[60.12]	[33.62]
Observations	5388	5377	5171	4184	4170	4022
R-squared	0.74	0.63	0.72	0.79	0.69	0.76

and consequently provide more credit to their customers, relative to firms that are more vulnerable at the outset of the crisis. These two sets of results reinforce our earlier conclusion that the observed post-crisis decline in trade credit is mainly driven by a supplyside effect.

4.3. Heterogeneous country-level response to crisis: Bank credit growth

To further test our explanation for crisis and post-crisis trade credit patterns, we study differences in the response of trade credit to aggregate bank credit behavior. The supplyside story would suggest that countries that experience a sharper decline in bank credit also

Table 6
Trade credit and bank credit growth

The dependent variables are the trade credit measures (see Table 2 for variable definitions). Credgr is the annual growth of bank credit to the private sector scaled by GDP for each country-year. This table shows the interactions of Credgr with the Crisis, Post1, Post2, and Post3 dummies. The models are estimated with firm-fixed effects (see model 3 in the paper) using an unbalanced sample. The standard errors are obtained using clustering on country and time as explained in the paper. ***, **, and *represent coefficients significant at the 1%, 5%, and 10% level. Absolute values of robust t-stats are in brackets.

	(1)	(2)	(3)	(4)	(5)	(6)
	Trectos	Tpaytoc	Ntcs	Trectos	Tpaytoc	Ntcs
Crisis	3.50	0.62	4.15	4.29	4.51	8.70
	[0.47]	[0.12]	[0.71]	[0.50]	[0.67]	[1.18]
Post1	6.45**	0.20	7.36***	8.53*	0.95	11.19***
	[2.41]	[0.11]	[3.19]	[1.79]	[0.35]	[2.60]
Post2	11.16**	1.63	13.68***	12.85***	0.26	13.56***
	[2.33]	[1.03]	[2.70]	[2.58]	[0.10]	[2.66]

Post3	19.08***	0.20	19.46***	20.08***	0.06	19.66***
[4.65] [0.05] [6.61] [4.77] [0.01] [5.87] Credgr	50.22**	11.68	42.42**	66.68*	14.11	56.98*
	[2.06]	[0.79]	[2.07]	[1.86]	[0.67]	[1.83]
CrisisCredgr	115.35**	65.71*	66.48	134.26**	37.26	115.67*
	[2.10]	[1.91]	[1.41]	[1.98]	[0.83]	[1.90]
Post1Credgr	81.57***	29.63	61.85**	89.67**	28.82	72.26**
	[2.74]	[1.32]	[2.42]	[2.29]	[1.22]	[2.03]
Post2Credgr	65.53***	22.80	48.00**	77.09**	26.39	57.85*
	[2.72]	[1.59]	[2.33]	[2.25]	[1.30]	[1.95]
Post3Credgr	19.35	8.27	10.34	38.64	8.11	32.98
	[0.63]	[0.33]	[0.41]	[0.95]	[0.27]	[0.93]
Cfw				4.90	6.94	18.18**
				[0.55]	[1.28]	[2.33]
Growth				4.19	5.71**	0.19
				[1.29]	[2.49]	[0.07]
Cashta				4.99	3.27	4.92
				[0.55]	[0.37]	[0.36]
Exchrgr				2.91	8.24*	10.29**
				[0.50]	[1.94]	[2.07]
Constant	101.19***	57.15***	59.22***	100.43***	57.50***	57.18***
	[44.33]	[48.93]	[27.43]	[34.24]	[25.12]	[19.19]
Observations	5529	5531	5302	4256	4244	4091
R-squared	0.75	0.63	0.72	0.79	0.69	0.77

experience a sharper decline in trade credit, i.e., that the supply of intermediated credit affects the supply of trade credit.

We test this conjecture using model 3, and report the results in Table 6. First, we observe a clear positive relation between bank credit growth and the extension of trade credit during a crisis period. Again, the positive response is most significant for receivables, and less so for payables, for which the coefficients are positive but not significant. We also find that the post-crisis decline

in the provision of trade credit (and, therefore, the decline in net credit) is sharper for countries that experience larger contractions in bank credit.[9]

The results of this section are again consistent with a supply-driven explanation, according to which contractions in bank credit are at least partially responsible for contractions in trade credit. Since most of the contraction in bank credit is likely to come in the form of short-term debt not being rolled over (long-term debt would not be immediately affected by the crisis), this result supports our earlier findings related to firms with higher shares of short-term debt. Our results are also in agreement with DemirgucKunt and Maksimovic (2001), who find that the provision of trade credit across countries is positively correlated with the level of development of financial intermediaries.

5. Conclusions

We study the behavior of trade credit around the time of financial crises. We find an increase in trade credit at the peak of financial crises, followed by a subsequent collapse of this source of financing right after crisis events.

Because these findings can be explained by either supply- or demand-side stories, we study firms' heterogeneous responses to crises and we characterize changes in trade credit policy around the time of a crisis as a function of a firm's relative financial vulnerability to crises. We concentrate our analysis on two alternative indicators of a firm's financial vulnerability, namely short-term debt and liquidity.

We find that before a crisis, firms with a high proportion of short-term debt are significant providers of trade credit. After a crisis, however, these firms sharply cut the amount of credit they extend to customers and they increase their reliance on credit from suppliers. In other words, what could be viewed as a favorable pre-crisis financial position (i.e., short-term debt) turns into a heavy disadvantage right after a crisis event. This crisisrelated change in financial position is associated with a corresponding change in trade credit policy. We also find some evidence that more liquid firms (i.e., those with high levels of cash stock or greater cash flow generating capacity) extend more credit to their customers and accept less credit from their suppliers.

Given that the reduction of trade credit provision is significantly higher for firms whose financial position is more vulnerable to crises, we conclude that a contraction in such credit is most likely driven by a supply-side effect. Thus, in the long aftermath of a crisis, trade credit contracts as a result of both an overall shortage of funds and difficulties experienced by firms that have a high reliance on short-term debt. Our results highlight the importance of aggregate bank credit availability, especially during times of financial crises.

Although our paper sheds some new light on the relation between bank credit and trade credit, it leaves many areas for future research. For instance, our data include only a few crises in a small set of countries, and thus we have some concern regarding degrees of freedom. In addition, the

[9] To ensure that our results on bank credit growth are not driven by the sensitivity of trade credit to overall economic conditions, we rerun our results while controlling for GDP growth and the interaction of GDP growth with the crisis and post-crisis dummies. We find that the crisis interaction loses some of its significance (to about the 11% level) while the post-crisis interactions remain significant at the same level. This suggests that bank credit growth affects trade credit beyond the effect of overall economic activity.

patterns we observe for the largest publicly traded firms might not generalize to the rest of the firm population. Thus, more research is needed to test whether the patterns we find hold for different firm sizes and whether our results are robust to a different sample of crisis episodes. Finally, our paper does not answer the question of whether trade credit helps firms survive a crisis, or whether it helps a firm increase market share and profitability after a crisis. These are important questions that warrant more research.

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