

# “The effect of 2008 financial crisis on trade credit: empirical evidences from Taiwan, China, Hong Kong, Japan and Korea”

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## The effect of 2008 financial crisis on trade credit: empirical evidences from Taiwan, China, Hong Kong, Japan and Korea

### Abstract

According to Love et al. (2007), most of firms in Mexico, Malaysia, Indonesia, Philippines and Thailand take the trade credit as the short-term financing resources during the 1994 Mexican peso devaluation and 1997 East Asian Financial Crisis. The 2008 financial crisis caused a global liquidity shortage. This paper investigates the effect of the 2008 financial crisis on companies' trade credit using five main East Asian countries as our research samples, which include Taiwan, China, Hong Kong, Japan and Korea. To investigate factors affecting trade credit, this study sets the accounts receivable/payable as the evaluation factors for trade credit and deduces two study themes, namely, financial crisis and financial vulnerability. The findings demonstrate that the financial crisis had a negative influence on the amount of trade credit use in these five countries. Further, the firms with a more vulnerable financial position before the crisis are more likely to reduce the supply on trade credit.

**Keywords:** trade credit, accounts receivable, accounts payable, financial crisis, financial vulnerability.

**JEL Classification:** G01, G15, G32.

### Introduction

Trade credit is widely used in many countries around the world. Based on the amount of trade credit use in China, Hong Kong, Taiwan, Japan and Korea from 1997 to 2011, we can find two interesting phenomena: First, the use of trade credit shows an increasing trend year by year in these five countries excluding Japan. Second, the use of accounts payable (AP) are greater than accounts receivable (AR) in China and Hong Kong, whatever Korea, Japan and Taiwan behave to the contrary.

In 2008, the international financial crisis spread from the America to global economies and is spilled over from the financial sector to the real economy. After the Lehman Brothers went bankrupt, many banks in the United States and Europe became financially distressed, these resulted in a tremendous credit crunch and global stock market tumbled. In Taiwan, the stock market dropped 24.33% from 6052.45 point on 15<sup>th</sup> September to 4579.62 point on 24<sup>th</sup> October. The exports of electronic product, plastic raw material and gasoline refined product decreased 3.6 billion dollars compared to previous year because the global demand has diminished. It was the first time that Taiwan's exports experience a negative growth rate from 2001. Further, the output value decreased 1.39% on industry and 1.13% on manufactory; it was the record low from December 2006.

Choi and Kim (2005) find that both accounts payable and accounts receivable of S&P 500 firms will increase with tighter monetary policy, which implies that trade credit helps firms absorb the effect of a credit contraction. Love et al. (2007) conclude that Mexico, Malaysia, Indonesia, Philippines and Thailand have used more trade credit as the short

term financing resource at the peak of financial crises, followed by a subsequent collapse of this source of financing right after the crisis events. According to the idea of these two papers mentioned above, we want to examine the effect of financial crisis on trade credit in five East Asian countries, including China, Hong Kong, Japan, Korea and Taiwan, which have major developments in the world during the past two decades.

### 1. Theory and hypotheses

In the literature, a number of theories have been developed to explain the use of trade credit. Laffer (1970) considers trade credit is a part of monetary supply and having an explanation for extending credit to small firms, which are categorized as the higher risk group by financial institutions. Schwartz (1974) points out that the suppliers have more advantages than traditional financial intermediaries in checking the credit situation of the demanders, and indicates the advantage of cash management by using trade credit. Ferris (1981) believes that trade credit is a hedging mechanism. Both of the sellers and buyers can convert the trading risk into a predictable cash-flow, allowing them to operate efficiently. Brick and Fung (1984) suggest that the buyers should consider the tax effect and compare with the interest rate cost of other lending channel to make a decision with minimum cost; the sellers will provide more trade credit when they are in a high tax rate level because interest is tax-deductible. Stowe & Gehr (1985) indicate that trade credit is a beneficial mechanism not only for the management of supply chain but also for reducing transaction costs of payment. Neale and Shipley (1985) and Emery (1988) conclude that when the implicit interest rate over the seller's cost of capital, trade credit creates the present value profit. Mian and Smith (1992) find that the more profit from using

market power by price discrimination, the more trade credit should be provided. Long et al. (1993) prove that firms use more trade credit in fluctuation market than in stable market. Petersen and Rajan (1997) confirm that firms will use more trade credit when deflation.

Petersen and Rajan (1997), Wilner (2000), Nilsen (2002), Fisman and Love (2003), and Atanasova and Wilson (2004) all suggest that when firms experience temporary liquidity shocks such as a restriction on bank loans, trade credit should become relatively more important as a source of finance. However, Love et al. (2007) use mainly large and publicly traded companies as sample to investigate the effect of two financial crises on trade credit in six emerging economies during the period of financial crisis. Garcia-Teruel and Martinez-Solano (2010) find that small and medium sized firms have a target level of accounts payable. In addition, larger firms use less credit from suppliers. In order to understand the causal relation between trade credit and bank credit around the time of the subprime financial crisis, Yang (2011) tests firms' financing behavior and finds bank credit and payable/receivable accounts are simultaneously determined and there is a substitute/complementary effect between bank credit and payable/receivable accounts. Bastos and Pindado (2013) investigate Argentina, Brazil and Turkey, which have undergone a financial crisis, and find empirical evidence that substitution hypothesis between bank credit and trade credit exists.

The 2008 financial crisis resulted in a globally liquidity shortage, and caused a lot of firms, no matter they are provider or demander of trade credit, to become more financial constrained. Therefore, we want to examine whether the following hypothesis will exist or not in these five countries.

*Hypothesis 1: Compared with the period before the 2008 financial crisis, trade credit will reduce during the 2008 financial crisis.*

After examining the aggregate results of the 2008 financial crisis on trade credit, we will investigate whether the financial vulnerability in the pre-crisis period has impact on trade credit. According to

Love et al. (2007), our identification strategy relies on pre-crisis indicators of firms' vulnerability combined with exogenous crisis events. Firms with more vulnerable financial position are more likely to be negatively affected by the crisis than less vulnerable firms.

Firstly, we use companies' reliance on short-term debt, which is the ratio of short-term debt to assets, to capture financial vulnerability in the pre-crisis period. The higher ratio indicates the more disadvantages on firms to renegotiate their debt during the crisis period because of the low liquidity.

Secondly, we use companies' net cash flow of operating as proxies for liquidity position of firms, both relative to firms' assets. Firms with a larger pre-crisis cash flow of operating have more advantage to pay the liabilities and better financial position to provide trade credit.

*Hypothesis 2: A negative impact of 2008 financial crisis on trade credit for firms with a high proportion of short term debt in the pre-crisis period.*

*Hypothesis 3: A positive impact of 2008 financial crisis on trade credit for firms with more cash flow in the pre-crisis period.*

## 2. Data

We study the 2008 financial crisis, which affected Taiwan, China, Hong Kong, Japan and Korea. The data are obtained from the Taiwan Economic Journal (TEJ) database, which has observations on publicly traded firms of these five countries.

Our study excludes all financial institutions (banks, insurance and investment companies), services sectors, and retail firms. If any research variable is missing in the whole research period, then this sample company will be excluded. As shown in Table 1, we have 934 firms in Taiwan, 854 firms in China, 476 firms in Hong Kong, 2205 firms in Japan and 290 firms in Korea. Due to the limitations in the database, we use quarterly data from 2006 to 2010 in Taiwan and China, yearly data from 2006 to 2010 in Korea, semi-yearly data from 2006 to 2010 in Hong Kong and Japan. Table 2 displays the summary statistics of the main variables used in our regressions.

Table 1. Data distribution by countries

Country	Firms	Observations	Data type
Taiwan	934	18680	Quarter 2006Q1-2010Q4
China	854	4269	Quarter 2006Q1-2010Q4
Hong Kong	476	61880	Semi-annual 2006Q2-2010Q4
Japan	2205	19793	Semi-annual 2006Q4-2010Q4
Korea	290	1445	Annual 2006-2010

Table 2. Summary statistics

Variable	N. of obs.	Min.	Median	Max.	Mean	St. dev.
Dependent variables						
Taiwan						
AR	18680	0.0000	0.1501	1.1887	0.1744	0.1248
AP	18680	0.0000	0.0798	1.5257	0.1096	0.1003
China						
AR	4269	0.0000	0.1066	8.4156	0.1357	0.2050
AP	4269	0.0000	0.0807	6.1384	0.1072	0.1349
Hong Kong						
AR	4760	-0.0073	0.1342	19.0177	0.1742	0.3215
AP	4760	-0.0478	0.0885	65.1058	0.1719	1.1762
Japan						
AR	19793	0.0000	0.1885	3.1935	0.2007	0.1446
AP	19793	0.0000	0.1025	3.4897	0.1291	0.1210
Korea						
AR	1445	0.0000	0.1669	1.7602	0.1901	0.1290
AP	1445	0.0000	0.0894	1.9814	0.1149	0.1074
Control variables						
Taiwan						
SIZE	18680	4.5998	6.4907	9.0550	6.5690	0.5880
S	18680	0.0001	0.1896	2.0170	0.2319	0.1797
C	18680	-0.0250	0.1492	1.9646	0.1954	0.1706
V	18680	0.0000	0.0931	0.9635	0.1336	0.1460
RE	18680	-11.5318	0.0566	0.6834	0.0065	0.3926
SDEBT	18680	0.0000	0.0343	0.8488	0.0767	0.1080
CASH	18680	0.0001	0.0677	0.9047	0.1093	0.1190
OCF	18680	-0.9267	0.0151	0.6518	0.0168	0.0548
GROWTH	18680	-0.9994	0.0423	750.7286	0.2844	7.6283
China						
SIZE	4269	4.4734	6.3368	8.9729	6.3733	0.5089
S	4269	-0.5956	0.1709	20.2081	0.2197	0.4168
C	4269	-0.6757	0.1283	15.3665	0.1730	0.3259
V	4269	0.0000	0.1399	0.8708	0.1608	0.1139
RE	4269	-29.1125	0.0645	0.7002	-0.0610	0.9209
SDEBT	4269	0.0000	0.1525	3.6121	0.1738	0.1651
CASH	4269	0.0000	0.1161	1.0000	0.1404	0.1079
OCF	4269	-0.4940	0.0242	1.3412	0.0274	0.0639
GROWTH	4269	-14.2538	0.1462	2197.7740	1.6458	43.5717
Hong Kong						
SIZE	4760	2.8597	5.9980	8.9682	6.0204	0.7989
S	4760	0.0004	0.5347	22.4074	0.7375	0.9017
C	4760	0.0000	0.3748	20.3324	0.5680	0.8276
V	4760	-0.0106	0.1056	0.7387	0.1267	0.1169
RE	4760	-515.3850	0.1445	0.9329	-0.6615	10.5394
SDEBT	4760	0.0000	0.0046	26.4410	0.0899	0.6367
CASH	4760	0.0004	0.1660	1.0000	0.2172	0.1777
OCF	4760	-32.2762	0.0214	1.8486	0.0071	0.4955
GROWTH	4760	-0.9998	0.0984	623.1801	1.0802	15.5890
Japan						
SIZE	19793	5.2939	7.6509	10.5301	7.6971	0.7334
S	19793	0.0000	0.7404	41.9289	0.8655	0.7177
C	19793	0.0000	0.5259	40.9457	0.6656	0.6347
V	19793	0.0000	0.1039	0.9313	0.1225	0.1115
RE	19793	-11.8257	0.2331	1.2205	0.2284	0.3891
SDEBT	19793	0.0000	0.0506	1.0526	0.0817	0.0950
CASH	19793	0.0002	0.1128	0.9483	0.1502	0.1298
OCF	19793	-2.3525	0.0418	6.9259	0.0423	0.0921
GROWTH	19793	-1.0000	0.0000	152.3323	0.0229	1.1293

Table 2 (cont.). Summary statistics

Variable	N. of obs.	Min.	Median	Max.	Mean	St. dev.
Korea						
SIZE	1445	7.3470	8.7274	11.0499	8.8556	0.7265
S	1445	0.0109	1.0027	23.6907	1.1140	0.8503
C	1445	0.0000	0.8018	21.1976	0.9049	0.7747
V	1445	0.0000	0.1031	0.4080	0.1135	0.0766
RE	1445	-3.0544	0.0224	1.9614	0.0531	0.1999
SDEBT	1445	0.0000	0.0971	0.6054	0.1239	0.1131
CASH	1445	0.0000	0.0538	0.4174	0.0671	0.0555
OCF	1445	-2.3084	0.0499	0.4328	0.0518	0.1016
GROWTH	1445	-0.9899	0.0938	100.8408	0.1896	2.6711

Note: AR, AP is measured as accounts receivable to assets and accounts payable to assets, respectively; SIZE is nature log of total assets; S is sales/asset ratio; C is the ratio of cost of goods sold to asset; V is inventory/asset ratio; RE is retained earnings/asset ratio; SDEBT is short-term debt/asset ratio; CASH is cash/asset ratio; OCF is operating cash flow/asset ratio; GROWTH is growth rate of sales.

### 3. Methodology

To avoid the problem of multi-collinearity, in this paper we use the Pearson's correlation coefficient method to make sure the correlation coefficient is less than 0.6 among all variables.

**3.1. Response variables.** Accounts receivable and accounts payable are the two main variables, which show the amount of trade credit that firms provide to their customers and obtain from suppliers, respectively. We scale these trade credit variables using beginning-of-period total assets because assets are more stable than sales or cost of goods sold. Under financial shocks, sales themselves have large fluctuations to cause additional changes in the ratio of trade credit to sales. In contrast, assets do not have big changes in short-term. The ratio scaled by assets contains better information about the change of amount of trade credit during the financial crisis period. To summarize, we use the following two dependent variables:

1. AR: Accounts Receivable /Total Assets.
2. AP: Accounts Payable /Total Assets.

**3.2. Explanatory variables.** According to Long et al. (1993), Calomiris et al. (1995), Petersen and Rajan (1997), and Love et al. (2007), we select several explanatory variables to control for factors that vary significantly over time. Also, we use the beginning-of-period value to avoid the endogenous problem. For the explanatory variables we include: Net Sales (S, Sales/Total Assets); Costs of sold (C, Costs of sold/Total Assets); Firm Size (Size, nature log of Total Assets); Inventory Stock (V, Inventories/Total Assets); Retained Earnings (RE, Retained Earnings/Total Assets); Firm's vulnerability (SDEBT, Short-term Debt/Total Assets); Liquidity (CASH, Cash Stock/Total Assets); Operating Cash Flow (OCF, Operating Cash Flow/Total Assets); Growth Rate of Sales (GROWTH).

We also define three dummy variables (CRISIS, POST1 and POST2) for the crisis and post-crisis years. POST1 and POST2 denote respectively first year and second year after the crisis, where each dummy equals one of the corresponding year and zero otherwise.

According to the previous statement, Table 3 and Table 4 show the expected sign of variables mentioned above. Table 5 indicates the dummy variables for crisis and post-crisis years.

Table 3. The determinants of accounts receivable

Variables	Proxy	Expected sign
S	Sales-assets ratio	+
SIZE	Log(total assets)	+/-
V	Inventory-assets ratio	+/-
RE	Retained earnings-assets ratio	+
SDEBT	Short-term debt-assets ratio	+
CASH	Cash-assets ratio	+/-
OCF	Operating cash flow to assets	+
GROWTH	Growth rate of sales	+

Table 4. The determinants of accounts payable

Variables	Proxy	Expected sign
C	Costs of goods sold to assets	+
SIZE	Log (total assets)	-
V	Inventory-assets ratio	+
RE	Retained earnings-assets ratio	-
SDEBT	Short-term debt-assets ratio	-
CASH	Cash-assets ratio	+/-
OCF	Operating cash flow to assets	-
GROWTH	Growth rate of sales	+

Table 5. Dummy variables for crisis-timing

Country	CRISIS	POST1	POST2
Taiwan	2008Q3-2009Q1	2009Q2-2009Q4	2010Q1-2010Q4
China	2008	2009	2010
Hong Kong	2008Q2-2008Q4	2009Q2-2009Q4	2010Q2-2010Q4
Japan	2008Q2-2008Q4	2009Q2-2009Q4	2010Q2-2010Q4
Korea	2008	2009	2010

**3.3. Linear regression model.** According to Love et al. (2007) and Kestens et al. (2012), this study estimates the regression model by using the firm fixed

$$AR_{i,t} = \alpha_i + \beta_1 CRISIS_t + \beta_2 POST1_t + \beta_3 POST2_t + \beta_4 S_{i,t} + \beta_5 SIZE_{i,t} + \beta_6 V_{i,t} + \beta_7 RE_{i,t} + \beta_8 SDEBT_{i,t} + \beta_9 CASH_{i,t} + \beta_{10} OCF_{i,t} + \beta_{11} GROWTH_{i,t} + \varepsilon_{i,t}. \quad (1)$$

$$AR_{i,t} = \alpha_i + \beta_1 CRISIS_t + \beta_2 POST1_t + \beta_3 POST2_t + \beta_4 C_{i,t} + \beta_5 SIZE_{i,t} + \beta_6 V_{i,t} + \beta_7 RE_{i,t} + \beta_8 SDEBT_{i,t} + \beta_9 CASH_{i,t} + \beta_{10} OCF_{i,t} + \beta_{11} GROWTH_{i,t} + \varepsilon_{i,t}. \quad (2)$$

Where  $i$  and  $t$  indicate firm and year, respectively;  $AR$ ,  $AP$  is measured as accounts receivable to assets and accounts payable to assets, respectively;  $SIZE$  is nature log of total assets;  $S$  is sales-assets ratio;  $C$  is costs of goods sold to assets ratio;  $V$  is inventory-assets ratio;  $RE$  is retained earnings to assets ratio;  $SDEBT$  is short-term debt to assets ratio;  $CASH$  is cash-assets ratio;  $OCF$  is operating cash flow to

affected estimator. To examine the first hypothesis: whether trade credit will decrease during the financial crisis, the following regression models are used:

assets ratio;  $GROWTH$  is growth rate of sales; and  $\varepsilon$  is an error term;  $CRISIS$ ,  $POST1$ , and  $POST2$  are dummy variables, which represent respectively crisis year, first year after the crisis and second year after the crisis.

To investigate the hypothesis 2 and hypothesis 3, the following models are used:

$$AR_{i,t} = \alpha_i + \beta_1 CRISIS_t + \beta_2 POST1_t + \beta_3 POST2_t + \beta_4 S_{i,t} + \beta_5 CRISIS_t \times SDEBT_{i,t} + \beta_6 POST1_t \times SDEBT_{i,t} + \beta_7 POST2_t \times SDEBT_{i,t} + \beta_8 SIZE_{i,t} + \beta_9 V_{i,t} + \beta_{10} RE_{i,t} + \beta_{11} CASH_{i,t} + \beta_{12} OCF_{i,t} + \beta_{13} GROWTH_{i,t} + \varepsilon_{i,t}. \quad (3)$$

$$AR_{i,t} = \alpha_i + \beta_1 CRISIS_t + \beta_2 POST1_t + \beta_3 POST2_t + \beta_4 C_{i,t} + \beta_5 CRISIS_t \times SDEBT_{i,t} + \beta_6 POST1_t \times SDEBT_{i,t} + \beta_7 POST2_t \times SDEBT_{i,t} + \beta_8 SIZE_{i,t} + \beta_9 V_{i,t} + \beta_{10} RE_{i,t} + \beta_{11} CASH_{i,t} + \beta_{12} OCF_{i,t} + \beta_{13} GROWTH_{i,t} + \varepsilon_{i,t}. \quad (4)$$

$$AR_{i,t} = \alpha_i + \beta_1 CRISIS_t + \beta_2 POST1_t + \beta_3 POST2_t + \beta_4 S_{i,t} + \beta_5 CRISIS_t \times OCF_{i,t} + \beta_6 POST1_t \times OCF_{i,t} + \beta_7 POST2_t \times OCF_{i,t} + \beta_8 SIZE_{i,t} + \beta_9 V_{i,t} + \beta_{10} RE_{i,t} + \beta_{11} CASH_{i,t} + \beta_{12} SDEBT_{i,t} + \beta_{13} GROWTH_{i,t} + \varepsilon_{i,t}. \quad (5)$$

$$AR_{i,t} = \alpha_i + \beta_1 CRISIS_t + \beta_2 POST1_t + \beta_3 POST2_t + \beta_4 C_{i,t} + \beta_5 CRISIS_t \times OCF_{i,t} + \beta_6 POST1_t \times OCF_{i,t} + \beta_7 POST2_t \times OCF_{i,t} + \beta_8 SIZE_{i,t} + \beta_9 V_{i,t} + \beta_{10} RE_{i,t} + \beta_{11} CASH_{i,t} + \beta_{12} SDEBT_{i,t} + \beta_{13} GROWTH_{i,t} + \varepsilon_{i,t}. \quad (6)$$

#### 4. Empirical results

This section will display the results of our three hypotheses. Liquidity ( $CASH$ ,  $OCF$ ) and payables are negatively related in China, Hong Kong, Japan and Korea (except Taiwan): firms with a higher liquidity position tend to demand less trade credit.

In table 5 and table 6 we examine model (1) and (2), respectively. The results indicate that both accounts receivable and accounts payable declined in these East Asian countries during the crisis period. The negative effect of the financial crisis continued but became smaller in both first and second years after the crisis. These results are different with the findings of Love et al. (2007). One possible reason for the decline of trade credit is the supply effect: lack of financial access to bank loans will force the firms to reduce the supply of trade credit to their customers. On the other hand, this result could come from the demand effect, that the buyers become less willing to take more credit. In these five East Asian countries, the financial crisis resulted in the global liquidity shortage and then caused companies to cut their offer of trade credit, and to overcompensate any potential increase in demand for trade credit due to the financial crisis.

The other results suggest that firms with high net sales/cost of goods sold experience an increase in accounts receivable/payable in all five countries. Larger firms in the studied countries except China are less likely to receive and provide trade credit. This result is consistent with the product theory which larger firms with more established reputations on their product will offer less trade credit to their customers but smaller firms will provide more trade credit to their customers to guarantee for product qualities because the lack of reputation. On the other hand, the significant negative effect on accounts payable indicates that larger firms have easier access to capital market or bank loans.

The  $V$  coefficient shows the negative effect on receivables in Taiwan, China and Korea: inventories and accounts receivable are substitutes to satisfy asset management view; a positive effect on receivables in Japan: the Japanese firms will provide more trade credit to stimulate sales in accordance with inventory management view. The negative effect on receivables is consistent with the findings of Choi and Kim (2005).

The RE coefficient shows the negative effect on payables (Taiwan, China and Hong Kong): firms with more retained earnings will use the internal sources of finance first. A positive effect on receivables indicates that firms with more retained earnings can offer more trade credit (only in Japan).

The short-term debt and accounts payable are negatively related in Taiwan, China, Hong Kong and Japan, but not significant in Korea. The negative relationship implies a substitute effect between short-term debt and accounts payable. Accounts receivable

and short-term debt are positively related only in Taiwan that implies a complementary effect between short-term debt and receivables.

The relationship between liquidity (CASH, OCF) and receivables is negative in all five countries: firms with a higher liquidity position tend to provide less trade credit to their customers. Liquidity (CASH, OCF) and payables are negatively related in China, Hong Kong, Japan and Korea (except Taiwan): firms with a higher liquidity position tend to demand less trade credit.

Table 6. General influence of financial crisis, accounts receivable

	Taiwan	China	Hong Kong	Japan	Korea
Constant	0.15381*** (11.0797)	-1.7314*** (-57.8013)	0.3537*** (15.4211)	1.3952*** (48.455)	0.4214*** (6.5521)
CRISIS	-0.006084*** (-15.2713)	-0.0289*** (-24.1501)	-0.0078*** (-5.0208)	-0.0042*** (-10.481)	-0.0024* (-1.6826)
POST1	-0.0124*** (-31.6741)	-0.0378*** (-30.8015)	-0.0094*** (-5.9921)	-0.0215*** (-51.009)	0.0058*** (3.7213)
POST2	-0.0109*** (-30.8747)	-0.0485*** (-39.6205)	-0.0039** (-2.3758)	-0.0138*** (-32.6805)	0.0175*** (10.1869)
S	0.5271*** (144.9156)	0.1776*** (34.6267)	0.0717*** (25.4133)	0.0360*** (56.0607)	0.1255*** (32.4539)
SIZE	-0.0124*** (-5.9205)	0.3036*** (63.2718)	-0.0378*** (-10.2299)	-0.1585*** (-42.4105)	-0.03932*** (-5.5359)
V	-0.0674*** (-12.4942)	-0.0928*** (-8.5693)	0.0098 (0.6115)	0.0845*** (10.2363)	-0.0864*** (-2.9093)
RE	0.0012 (1.2232)	-0.4186*** (-212.8385)	-0.0015*** (-3.0486)	0.0112*** (7.4708)	-0.0040 (-0.6498)
SDEBT	0.0273*** (7.0490)	-0.2573*** (-35.1213)	-0.0067*** (-2.7140)	-0.0362*** (-6.9405)	0.0041 (0.3514)
CASH	-0.0551*** (-18.849)	-0.2501*** (-29.3982)	-0.0143** (-2.2091)	-0.0242*** (-5.8750)	-0.1541*** (-7.9885)
OCF	-0.1209*** (-30.143)	-0.1517*** (-14.8078)	-0.0210*** (-3.3492)	-0.0862*** (-21.5308)	-0.1002*** (-10.1946)
GROWTH	-0.0003 (-1.0117)	-0.0004 (-2.7224)	0.0012*** (5.7752)	0.0181*** (23.9410)	-0.0111*** (-8.0183)
N. of obs.	18680	17056	4760	19793	1445
Adj R-square	0.95	0.86	0.84	0.95	0.94

Note: CRISIS, POST1 and POST2 are the crisis timing dummy variables; SIZE is nature log of total assets; S is sales/asset ratio; V is inventory/asset ratio; RE is retained earnings/asset ratio; SDEBT is short-term debt/ asset ratio; CASH is cash/asset ratio; OCF is operating cash flow/asset ratio; GROWTH is growth rate of sales.

Table 7. General influence of financial crisis, accounts payable

	Taiwan	China	Hong Kong	Japan	Korea
Constant	0.1273*** (13.5718)	-0.57584*** (-41.3147)	0.4100*** (16.3730)	0.6024*** (28.4931)	0.4214*** (6.5521)
CRISIS	-0.006205*** (-22.2132)	-0.0056*** (-10.1228)	-0.0011 (-0.7299)	-0.0048*** (-13.3407)	-0.0024* (-1.6826)
POST1	-0.0036*** (-12.8726)	-0.0065*** (-11.4511)	0.0048*** (3.0748)	-0.0251*** (-65.9114)	0.005*8** (3.7213)
POST2	-0.0013*** (-5.1262)	-0.0092*** (-16.2161)	0.0111*** (6.5417)	-0.0186*** (-48.9267)	0.0175*** (10.1869)
C	0.3912*** (102.1773)	0.1592*** (47.1593)	0.0659*** (21.2547)	0.0315*** (45.4423)	0.1255*** (32.4533)
SIZE	-0.0129*** (-9.1678)	0.1065*** (48.0555)	-0.0454*** (-11.2936)	-0.0640*** (-23.3887)	-0.0393*** (-5.5359)
V	-0.0429*** (-9.5286)	0.0151*** (2.9948)	0.0092 (0.6788)	0.1188*** (17.6670)	-0.0864*** (-2.9093)
RE	-0.0036*** (-4.1595)	-0.1528*** (-199.9671)	-0.0124*** (-5.7694)	0.0042*** (6.6212)	-0.0041 (-0.6498)

Table 7 (cont.). General influence of financial crisis, accounts payable

	Taiwan	China	Hong Kong	Japan	Korea
SDEBT	-0.0308*** (-10.33081)	-0.0979*** (-27.9634)	-0.0143** (-2.2269)	-0.0320*** (-7.7825)	0.0042 (0.3515)
CASH	0.0052*** (2.8872)	-0.1010*** (-25.4060)	-0.0641*** (-8.1580)	-0.0168*** (-5.3776)	-0.1541*** (-7.9885)
OCF	0.0126*** (4.5150)	-0.0251*** (-5.1184)	-0.0217*** (-2.7177)	-0.0312*** (-10.8900)	-0.1003*** (-10.1947)
GROWTH	0.0003** (2.0514)	0.000004 (0.4083)	0.0009*** (3.6727)	0.0116*** (20.5073)	-0.0112*** (-8.0183)
N. of obs.	18680	17056	4760	19793	1445
Adj R-square	0.92	0.87	0.81	0.93	0.94

Note: CRISIS, POST1 and POST2 are the crisis timing dummy variables; SIZE is nature log of total assets; C is costs of goods sold/asset; V is inventory/asset ratio; RE is retained earnings/asset ratio; SDEBT is short-term debt/asset ratio; CASH is cash/asset ratio; OCF is operating cash flow/asset ratio; GROWTH is growth rate of sales.

We investigate whether the financial vulnerability in the pre-crisis period has the impact on trade credit. Following Love et al. (2007), this paper uses pre-crisis ratio of short-term debt to assets as proxy of financial vulnerability to estimate hypothesis 2: a negative impact of 2008 financial crisis on trade credit for firms with a high proportion of short-term debt in the pre-crisis period. Because the pre-crisis level of short-term debt is not time-varying, we subsumed it into the fixed effects. Thus, we can only observe the differential responses to crisis events. We estimate model (3) and (4) and present results in Table 7 and Table 8, respectively.

The interaction term CRISISDEBT in Table 7 is negative in China. It indicates that, in Chinese firms with higher pre-crisis level of short-term debt will provide less trade credit to their customers in the crisis period. A possible reason is that firms are

unable to renew their short-term debt and thus experience more financial difficulties during the financial crisis. Another possible reason is from the view of information asymmetry and moral hazard. Firms do not have correct information about their customers, so they will not extend more trade credit during the crisis period. The result is also consistent with Love et al. (2007) that firms with high short-term debt have a preferable financial position before the crisis and a disadvantaged financial position after the crisis. For the accounts payable in Table 8, our results show a significantly negative coefficient for the interaction terms CRISIS SDEBT and POST1SDEBT in Taiwan and China. It indicates that, firms with high short-term debt in pre-crisis period experience a decrease in payables during and one year after the crisis. The result is not consistent with Love et al. (2007).

Table 8. Trade credit and short-term debt, accounts receivable

	Taiwan	China	Hong Kong	Japan	Korea
Constant	0.146885*** (10.56929)	-1.526527*** (-50.94529)	0.349538*** (15.24355)	1.407864*** (48.84112)	0.414265*** (6.399739)
CRISIS	-0.006307*** (-13.25442)	-0.0089*** (-4.993148)	-0.008118*** (-5.046619)	-0.003783*** (-7.226082)	-0.003522* (-1.855072)
POST1	-0.012178*** (-26.51955)	-0.011944*** (-6.728416)	-0.009417*** (-6.631352)	-0.020271*** (-37.57485)	0.005092** (2.395845)
POST2	-0.010898*** (-26.29366)	-0.016699*** (-10.40212)	-0.003006* (-1.724005)	-0.0134*** (-25.17125)	0.018977*** (8.420568)
CRISIS SDEBT	0.003588 (0.841462)	-0.082633*** (-9.56625)	0.004496 (0.557661)	-0.005713 (-1.216402)	0.008421 (0.721895)
POST1SDEBT	-0.003864 (-0.893573)	-0.111669*** (-13.1545)	-0.014432 (-0.85535)	-0.019591*** (-4.381922)	0.004699 (0.356783)
POST2SDEBT	-0.002929 (-0.745215)	-0.143471*** (-19.26228)	-0.030209* (-1.908772)	-0.009414** (-2.136826)	-0.011757 (-0.85097)
S	0.525106*** (144.6521)	0.183142*** (36.51372)	0.070974*** (25.11281)	0.035821*** (55.73238)	0.125198*** (32.54323)
SIZE	-0.011093*** (-5.275119)	0.262887*** (55.04234)	-0.036917*** (-9.994903)	-0.160474*** (-42.93045)	-0.038412*** (-5.372743)
V	-0.061524*** (-11.44853)	-0.090288*** (-9.278552)	0.007798 (0.486969)	0.081299*** (9.841922)	-0.084974*** (-2.907289)
RE	0.000661 (0.673259)	-0.402904*** (-181.8683)	-0.001332*** (-2.711751)	0.011901*** (8.027591)	-0.003848 (-0.598762)
CASH	-0.05687*** (-19.47425)	-0.217581*** (-28.50752)	-0.017983*** (-2.786919)	-0.02338*** (-5.697328)	-0.155508*** (-7.96447)



Table 8 (cont.). Trade credit and short-term debt, accounts receivable

	Taiwan	China	Hong Kong	Japan	Korea
OCF	-0.118866*** (-29.73152)	-0.177081*** (-18.81664)	-0.017003*** (-2.787885)	-0.085096*** (-21.18661)	-0.102197*** (-10.26677)
GROWTH	-0.0000308 (-0.885542)	-0.0000536*** (-3.533879)	0.001224*** (5.742861)	0.017918*** (23.67314)	-0.011039*** (-7.890226)
N. of obs.	18680	17056	4760	19793	1445
Adj R-square	0.95	0.85	0.84	0.95	0.94

Note: CRISIS, POST1 and POST2 are the crisis timing dummy variables; CRISIS SDEBT, POST1SDEBT, POST2SDEBT are the interaction terms between crisis timing and short-term debt; SIZE is nature log of total assets; S is net sales/asset ratio; V is inventory/asset ratio; RE is retained earnings/asset ratio; SDEBT is short-term debt/asset ratio; CASH is cash/asset ratio; OCF is operating cash flow/asset ratio; GROWTH is growth rate of sales.

Table 9. Trade credit and short-term debt, accounts payable

	Taiwan	China	Hong Kong	Japan	Korea
Constant	0.135009*** (14.36892)	-0.583596*** (-41.67567)	0.362627*** (14.23846)	0.612536*** (28.97947)	0.066887 (1.257609)
CRISIS	-0.005783*** (-17.9909)	-0.000253 (-0.287905)	-0.002145 (-1.361578)	-0.004364*** (-9.532998)	-0.001525 (-1.196858)
POST1	-0.002771*** (-8.759546)	0.001174 (1.357575)	0.002983* (1.824413)	-0.02227*** (-47.44989)	0.001307 (0.908109)
POST2	-0.000252 (-0.874718)	0.0005 (0.650713)	0.004509** (2.562658)	-0.016521*** (-36.03586)	0.005609*** (3.588282)
CRISIS SDEBT	-0.005699* (-1.758217)	-0.029697*** (-6.970542)	-0.0038 (-0.257244)	-0.006495 (-1.523519)	-0.007102 (-0.783314)
POST1 SDEBT	-0.013187*** (-4.04455)	-0.04546*** (-10.82377)	-0.002319 (-0.105839)	-0.038987*** (-9.604479)	0.012782 (1.468968)
POST2 SDEBT	-0.014106*** (-4.721244)	-0.055773*** (-15.05511)	0.112783*** (5.058034)	-0.028661*** (-7.446155)	0.007638 (0.76319)
C	0.392447*** (102.1708)	0.162029*** (47.70189)	0.062923*** (20.37102)	0.031361*** (45.31898)	0.097359*** (24.58422)
SIZE	-0.01436*** (-10.14412)	0.104769*** (47.18531)	-0.037931*** (-9.30633)	-0.06571*** (-24.02808)	-0.003749 (-0.640623)
V	-0.050289*** (-11.27361)	0.015477*** (3.311784)	0.016575 (1.184267)	0.119135*** (17.66954)	-0.050741** (-2.349088)
RE	-0.003605*** (-4.328031)	-0.149102*** (-172.7334)	-0.012461*** (-5.959804)	0.004796*** (7.913574)	-0.011389*** (-3.126122)
CASH	0.004937*** (2.740139)	-0.089678*** (-23.66942)	-0.053841*** (-7.141919)	-0.014832*** (-4.8368)	-0.037297*** (-3.235284)
OCF	0.010091*** (3.669195)	-0.034651*** (-7.268216)	-0.021456*** (-2.761627)	-0.029131*** (-10.38567)	0.014481** (2.016249)
GROWTH	0.0000352* (1.923487)	0.00000473 (0.419625)	0.000812*** (3.354114)	0.011116*** (20.09042)	-0.001521 (-1.515755)
N. of obs.	18680	17056	4760	19793	1445
Adj R-square	0.920219	0.874608	0.808009	0.93932	0.934738

Note: CRISIS, POST1 and POST2 are the crisis timing dummy variables; CRISIS SDEBT, POST1 SDEBT, POST2 SDEBT are the interaction terms between crisis timing and short-term debt; SIZE is nature log of total assets; S is net sales/asset ratio; V is inventory/asset ratio; RE is retained earnings/asset ratio; SDEBT is short-term debt/asset ratio; CASH is cash/asset ratio; OCF is operating cash flow/asset ratio; GROWTH is growth rate of sales.

In Table 9 and 10 we examine models (5) and (6), using the pre-crisis operating cash flow to assets ratio as an alternative indicator of firms' financial position. The interaction term CRISISOCF in Table 9 is negative in all five countries. It indicates that firms with low pre-crisis operating cash flow provide more trade credit to their customers during the crisis period. The result is not consistent with the findings of Love et al. (2007). A possible reason is that firms with low pre-crisis operating cash flow want to stimulate the sales to avoid

bankruptcy during the global recession, so they will provide more trade credit to their customers.

For the accounts payable in Table 10, our results show a significantly negative coefficient for the interaction term CRISISOCF in Taiwan and Hong Kong. It indicates that, firms with more operating cash flow (on a better financial position) in pre-crisis period rely less on credit from suppliers. The result is consistent with the findings of Love et al. (2007).

Table 10. Trade credit and cash flow, accounts receivable

	Taiwan	China	Hong Kong	Japan	Korea
Constant	0.082801*** (3.425857)	-1.674621*** (-55.39971)	0.359322*** (15.67905)	1.614253*** (34.05766)	0.410744*** (5.913752)
CRISIS	-0.007844*** (-7.694013)	-0.027498*** (-21.98289)	-0.007253*** (-4.538097)	-0.002474** (-2.155375)	0.002717 (1.618184)
POST1	-0.018724*** (-18.88905)	-0.035533*** (-26.30244)	-0.009122*** (-5.589695)	-0.02588*** (-22.27623)	0.007862*** (3.824317)
POST2	-0.016585*** (-19.09356)	-0.046745*** (-37.33294)	-0.00364** (-2.177295)	-0.014587*** (-12.91226)	0.024347*** (10.96554)
CRISISOCF	-0.16815*** (-12.55596)	-0.427758*** (-3.770125)	-0.022769** (-2.180952)	-0.086306*** (-7.334717)	-0.071041*** (-4.096058)
POST1OCF	-0.149214*** (-8.68371)	-0.111781*** (-4.275449)	-0.011897 (-0.861634)	-0.096715*** (-8.722044)	-0.050084*** (-3.596284)
POST2OCF	-0.144425*** (-10.82706)	-0.028599 (-1.459667)	-0.002515 (-0.190719)	-0.04289*** (-6.24603)	-0.122205*** (-6.676373)
S	0.470093*** (106.5289)	0.179751*** (35.63223)	0.070883*** (25.21869)	0.054682*** (62.94892)	0.123267*** (30.80363)
SIZE	0.002674 (0.722602)	0.293869*** (60.75091)	-0.038809*** (-10.49203)	-0.189646*** (-30.83027)	-0.038393*** (-5.009942)
V	-0.133792*** (-16.83019)	-0.100243*** (-9.097166)	0.009712 (0.604556)	0.129101*** (9.896434)	-0.109739*** (-3.516186)
RE	-0.000023 (-0.018353)	-0.422913*** (-217.8848)	-0.00166*** (-3.216627)	0.013004*** (6.57645)	0.002567 (0.390542)
CASH	0.0212*** (3.22085)	-0.259762*** (-34.77728)	-0.00599** (-2.423293)	-0.045715*** (-4.442761)	0.006342 (0.493525)
SDEBT	-0.092121*** (-16.37323)	-0.226181*** (-26.84185)	-0.013318** (-2.056044)	-0.031504*** (-3.81231)	-0.135022*** (-7.366012)
GROWTH	0.0000641 (1.496698)	-0.000048** (-2.554308)	0.001228*** (5.755508)	0.003032*** (8.15929)	-0.01143*** (-9.781424)
N. of obs.	18680	17056	4760	19793	1445
Adj R-square	0.882475	0.864519	0.846550	0.860382	0.934738

Note: CRISIS, POST1 and POST2 are the crisis timing dummy variables; CRISISOCF, POST1OCF, POST2OCF are the interaction terms between crisis timing and operating cash flow; SIZE is nature log of total assets; S is net sales/asset; V is inventory/asset ratio; RE is retained earnings/asset ratio; SDEBT is short-term debt/asset ratio; CASH is cash/asset ratio; OCF is operating cash flow/asset ratio; GROWTH is growth rate of sales.

Table 11. Trade credit and cash flow, accounts payable

	Taiwan	China	Hong Kong	Japan	Korea
Constant	0.123918*** (13.43985)	-0.571027*** (-40.69304)	0.421397*** (16.23179)	0.552125*** (12.49505)	0.078019 (1.487612)
CRISIS	-0.005747*** (-18.26079)	-0.005771*** (-9.732354)	-0.000405 (-0.2294)	-0.009334*** (-8.662246)	-0.002335* (-1.888638)
POST1	-0.003722*** (-11.44481)	-0.006077*** (-9.470485)	0.003122* (1.64955)	-0.042721*** (-39.23701)	0.001211 (0.834955)
POST2	-0.001362*** (-4.970333)	-0.009166*** (-15.58237)	0.007493*** (4.108467)	-0.029831*** (-28.18223)	0.004745*** (2.865967)
CRISISOCF	-0.009814** (-1.991525)	0.038455 (0.707249)	-0.040968** (-2.573047)	-0.003157 (-0.2863)	-0.006733 (-0.603378)
POST1OCF	0.008929 (1.18455)	-0.034491*** (-2.599704)	-0.025539 (-1.382263)	0.033496*** (3.216733)	0.025755*** (2.66189)
POST2OCF	0.002779 (0.512064)	0.006461 (0.639542)	0.040845*** (2.868626)	-0.002967 (-0.460216)	0.020198 (1.492666)
C	0.388999*** (101.8027)	0.165236*** (48.48691)	0.06359*** (20.80004)	0.054352*** (59.57155)	0.095209*** (24.22983)
SIZE	-0.012349*** (-8.89726)	0.10558*** (47.34324)	-0.046914*** (-11.28567)	-0.059856*** (-10.42959)	-0.004611 (-0.798601)
V	-0.042284*** (-9.497965)	0.014102*** (2.667717)	0.008006 (0.575407)	0.219098*** (17.89142)	-0.050502** (-2.277484)
RE	-0.003656*** (-4.187234)	-0.153284*** (-203.4039)	-0.013436*** (-6.124994)	0.003998** (2.152635)	-0.011583*** (-2.787288)
CASH	-0.028876*** (-9.850848)	-0.099594*** (-27.79542)	-0.018101*** (-3.12805)	-0.046317*** (-4.791261)	-0.004357 (-0.454614)
SDEBT	0.003244* (1.83654)	-0.096533*** (-24.28999)	-0.067296*** (-7.956039)	-0.030368*** (-3.910358)	-0.037583*** (-2.970193)

Table 11 (cont.). Trade credit and cash flow, accounts payable

	Taiwan	China	Hong Kong	Japan	Korea
GROWTH	0.0000369** (2.020554)	0.00000558 (0.487689)	0.000995*** (4.042992)	0.002572*** (7.358615)	-0.001135 (-1.166427)
N. of obs.	18680	17056	4760	19793	1445
Adj R-square	0.920638	0.880808	0.800801	0.823759	0.931286

Note: CRISIS, POST1 and POST2 are the crisis timing dummy variables; CRISISOCF, POST1OCF, POST2OCF are the interaction terms between crisis timing and operating cash flow; SIZE is nature log of total assets; C is cost of goods sold/asset ratio; V is inventory/asset ratio; RE is retained earnings/assets ratio; SDEBT is short-term debt/asset ratio; CASH is cash/asset ratio; OCF is operating cash flow/assets ratio; GROWTH is growth rate of sales.

## Conclusions

Based on the large panel data set of Taiwanese, Chinese, Hong Kong, Japanese and Korean companies, we study the behavior of trade credit during the period of 2008 financial crisis following the framework and studies of Love et al. (2007) and Choi and Kim (2005).

We find a reduction in trade credit (both accounts receivable and accounts payable) during the 2008 financial crisis in Taiwan, China, Hong Kong, Japan and Korea. That is, financial crisis caused a negative impact on the overall availability of trade credit. Attributing to supply effect, lack of financial access to bank loans force the firms to reduce the supply of trade credit to their customers. Under demand effect, buyers become less willing to take more credit.

Furthermore, we study whether companies' pre-crisis financial vulnerability will affect the use of

trade credit when the crisis occurs. We use short-term debt and operating cash flow to be the proxies of financial vulnerability. We find that firms which rely more on short-term debt in pre-crisis period provide less trade credit to their customers in the crisis period in China; and experience a decrease in payables during and one year after the crisis in Taiwan and China.

We also find that firms with low pre-crisis operating cash flow will provide more trade credit to their customers during the crisis period in all five countries; and rely more on credit from suppliers during the crisis period in Taiwan and Hong Kong.

To sum up, our findings demonstrate that the financial crisis has a negative influence on trade credit in Taiwan, China, Hong Kong, Japan, and Korea. And this effect is concluded by a companies' pre-crisis dependence on short-term debt financing and a companies' liquidity during crisis year.

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