DIGITALES ARCHIV

Song, E. Young

Article

Trade Finance and Trade Collapse during the Global Financial Crisis: Evidence from the Republic of Korea

Provided in Cooperation with:
Korea Institute for International Economic Policy (KIEP), Sejong-si

Reference: Song, E. Young Trade Finance and Trade Collapse during the Global Financial Crisis: Evidence from the Republic of Korea.

This Version is available at:
http://hdl.handle.net/11159/333

Trade Finance and Trade Collapse during the Global Financial Crisis: Evidence from the Republic of Korea*

E. Young Song
Professor, Department of Economics, Sogang University
eysong@sogang.ac.kr

This study examines the role of trade finance in the trade collapse of 2008-09 from the perspective of the Korean economy. We use two approaches. Firstly, as background to a more formal analysis, we make a casual observation on the behavior of aggregate data on trade finance, on which Korea has relatively abundant data. Aggregate data do not convincingly support the view that trade finance played an active role in causing the trade collapse. The measures of trade finance and the value of trade both dropped sharply, but the ratio of trade finance over trade was stable and in some cases increased during the crisis period.

Secondly, using quarterly data on listed firms in Korea, we conduct panel estimations to test whether firms that are more dependent on external finance experienced greater export contraction during the crisis. Our regression analysis suggests that the financial vulnerability of firms, measured by various financial ratios, did not contribute to export contraction during the financial crisis. This observation largely applies even to smaller firms, who are usually thought of as being more vulnerable financially. However, we find that small exporters that relied heavily on cross-border trade payables or receivables suffered larger drops in export growth during the crisis.

Keywords: Credit Constraints, Firms' Heterogeneity, Trade Credit, Financial Crisis, Export
JEL Classification: F10, G01, F14

I. Introduction

As soon as the Global Financial Crisis of 2008-09 broke out, economists, policy makers and the leaders of the world economy expressed concerns about the adverse effects of financial contraction on world trade, and called for coordinated efforts to prevent a drying-up of trade finance. The G-20 quickly convened and agreed on the need to expand trade finance liquidity, and national governments and international agencies set up programs to supply additional liquidity to finance trade transactions.

Despite these efforts, world trade volume contracted 10.7 percent during 2009, while world GDP contracted 0.6 percent according to the International Monetary Fund (2010). The disproportionately large contraction of trade during the Global Financial Crisis is named the Great Trade Collapse, and many studies attempt to offer explanations. Now there seems to have developed a consensus that most of the fall in trade can be explained by demand contraction caused by the Global Financial Crisis. The recession hit especially hard the demand for consumer durables, manufactured intermediate goods and capital goods, and world trade is concentrated on these kinds of goods.[1] However, some observers still find this observation inadequate for explaining trade collapse far larger than GDP contraction. The fall in trade is bigger than most econometric and CGE models would predict, and they argue that there must be supply-side causes, such as a shortage of trade finance or a breakdown of supply chains.

Now we have a large body of literature that examines the role of trade finance during the trade collapse of 2009. Many econometric studies present evidence that trade finance played a significant role in causing trade collapse (Amiti and Weinstein, 2011, Chor and Manova, 2012 and Bricongne et al., 2012), while there are others that disagree (Levchenko, Lewis and Tesar, 2010 and Behrens, Corcos and Mion, 2010). In contrast, informal studies using survey results or direct data on trade finance tend to find the limited role of trade finance in the Great Trade Collapse. For example, many chapters summarized in the World Bank volume edited by Chauffour and Malouche (2011) express this kind of

---

[1] Eaton et al. (2010) find that more than 80 percent of the decline in the ratio of trade to GDP resulted from an expenditure shift away from manufactured goods, particularly durable goods. Bricongne et al. (2012) find that the impact of finance on the export collapse in France was quantitatively small even though its effect is statistically significant. Asmundson et al. (2011), Behrens, Corcos and Mion (2010) and Committee on the Global Financial System (2014), for example, echo similar views.

skepticism. We need more country-based studies to obtain a comprehensive picture on the role of trade finance in the trade collapse.

This paper examines the role of trade finance in the trade collapse of 2009 from the perspective of the Korean economy. We use two approaches. Firstly, we make a casual observation on aggregate data to find an indication that trade finance affected trade volume during the crisis. Korea has relatively rich data on trade finance and trade credit. The Bank of Korea publishes aggregate data on "foreign trade loans", which are loans extended by commercial banks to exporters for the purpose of providing working capital. The Bank also publishes aggregate data on cross-border accounts receivable and payable of private firms, allowing us to track the volume of inter-firm trade credit. The Financial Supervisory Service of Korea reports two sets of data on trade finance: "documentary bills purchased" by commercial banks and "domestic import usances". We find that the aggregate data do not strongly support the view that trade finance played an active role in causing the trade collapse. The measures of trade finance and the value of trade concurrently dropped, but the ratio of trade finance over trade was stable, and in some cases increased during the crisis period. The aggregate data are consistent with the hypothesis that trade collapse caused trade finance contraction, rather than the other way round.

The second approach of this paper is an econometric examination using firm-level data. Using quarterly data on listed firms in Korea, we conduct panel estimations to test whether exporters with more dependence on external finance or with more reliance on inter-firm trade credit were more vulnerable to the crisis. We adopt firm-level estimations for two reasons. A major problem in estimating the effect of trade finance on trade is to discern whether the fall in trade was due to inadequate trade finance or lower demand. In panel estimation using firm-level data, we can control for industry-specific demand shocks by industry-time dummies. The second reason for using firm-level data is related to the structure of the Korean economy. Most exports from Korea are made by top 30 giant exporters, almost every one of which belongs to a large business group called Chaebol. It is unlikely that these firms were seriously credit-constrained during the crisis. If some firms suffered from a shortage of trade finance, they would be small or medium-sized firms. The effects through SMEs would not show up at industry-level exports where giant firms dominate.

There are a growing number of studies that use firm-level data to test the influence of finance on exports using the difference-in-differences method pioneered by Rajan and Zingales (1998). This paper follows this line of

literature, but it can be differentiated in three aspects. Firstly, our data set allows us to check whether the ratio of exports to domestic sales, not the absolute amount of exports, fell more for financially vulnerable firms during the crisis. This approach is required because the challenge here is to find out whether a shortage of trade finance caused a proportionally larger drop of exports than of output. Secondly, we focus on the effect of finance on small exporters, especially on the interaction between the smallness of firms and their financial characteristics. Lastly, we utilize firm-level data on cross-border accounts receivable and payable. Past studies had to rely on data on total trade credit (domestic plus foreign credit), even though data on cross-border credit are required, simply because data on cross-border trade credit were not available.

Our regression analysis suggests that the financial vulnerability of firms, measured by dependence on external fund in investment, the availability of collaterlizable assets, dependence on domestic or international inter-firm trade credit, or dependence on domestic or foreign short-term borrowings, did not contribute to export contraction during the financial crisis. This observation largely applies even to smaller firms, who are usually thought financially more vulnerable. However, our analysis suggests that cross-border trade credit markets did tighten for small exporters that depend heavily on trade credit to import intermediate goods or to export their products. The export contraction of small exporters was intensified, not through the usual channel of bank loans, but by the tightening of international inter-firm trade credits. This paper suggests that policy makers should seriously consider this transmission channel when they design policies for small exporters at a time of financial crisis.

The paper is organized as follows. Section II presents a snapshot of the Korean experience during the crisis based on aggregate data. Section III reports estimation results from the firm-level analysis. Section IV concludes.

II. A Snapshot of Exports and Trade Finance

Figure 1 shows that the won/dollar exchange rate has been rising slowly well before the Lehman shock in September, 2008. The exchange rate then shot up with the Lehman crisis, and by March, 2009, at the peak of financial turmoil, the won depreciated more than 40% from the pre-crisis level. Because of the sharp depreciation, the won prices of Korean exports did not fall much despite a sharp fall in dollar prices, and the won price index actually remained above the pre-crisis level at the height of the Lehman shock. Because of stable export

Figure 1. Export price, quantity and value (in Korean won)
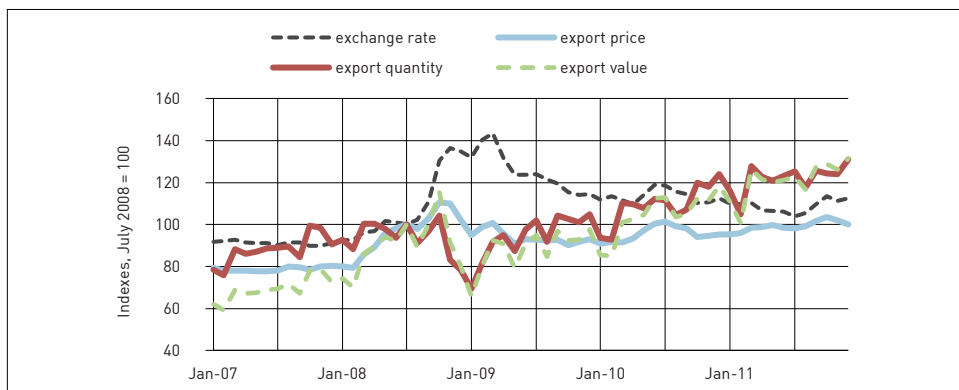
Source: Economic Statistics System, Bank of Korea
All variables are indexes. value = price × quantity. The indexes in July 2008 are normalized to 100. Price and value indexes in KRW are obtained by multiplying dollar indexes by exchange rates.

prices, the won value of exports moved in tandem with the quantity of exports during the crisis. Both measures of exports hit the bottom in January, 2009, dropping about 35% from the pre-crisis level. Then they recovered slowly throughout the crisis period.

Figure 2. Foreign trade loans and exports (in Korean won)
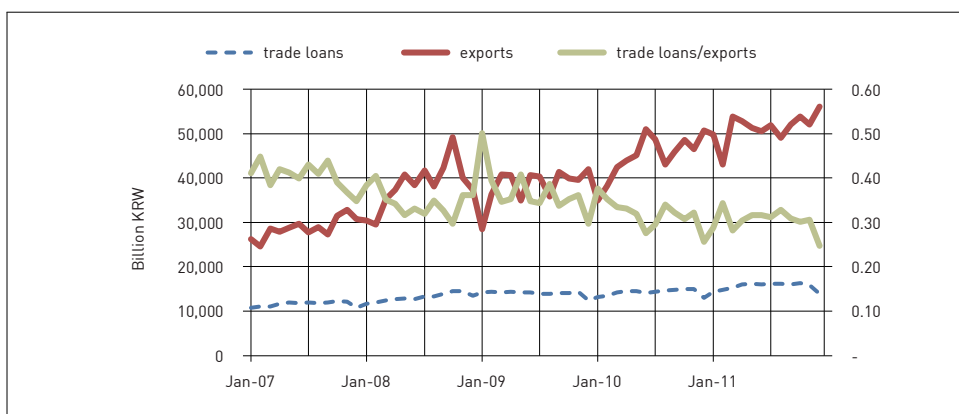
Source: Economic Statistics System, Bank of Korea
Trade loans and exports are shown on the left axis. The value of exports was converted into KRW using average monthly exchange rates. The ratio of foreign trade loans to exports are shown on the right axis.

Figure 2 traces the behavior of foreign trade loans around the crisis period. Foreign trade loans denote credits extended by commercial banks to domestic exporters and export-related firms for the purpose of providing them with working capital necessary for export-related business. The Bank of Korea collects and publishes monthly data on foreign trade loans. These loans are treated as domestic local currency loans of commercial banks because they are denominated in Korean won. We can see from the figure that except for seasonal drops in December, the amount of foreign trade loans was relatively stable during the crisis period.[2] The ratio of trade loans to exports did not drop below the downward trend line during the crisis period and even peaked in January 2009, at the height of the crisis. From the graph, it is hard to argue that a sudden contraction in foreign trade loans initiated the export collapse of late 2008 and early 2009.

Figure 3. Documentary bills purchased and exports (in US dollar)
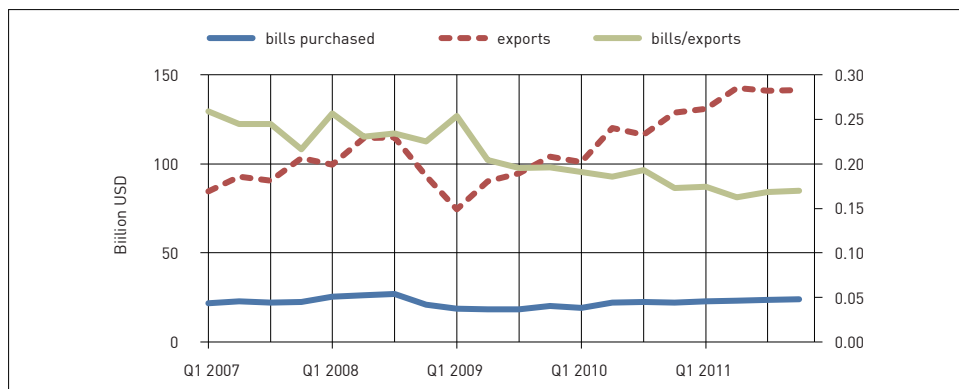
Source: Financial Supervisory Service of Korea
Observations are quarterly. Bills purchased and exports are shown on the left axis. The ratio of bills purchased to exports are shown on the right axis. The amount of bills purchased was converted to dollar value using exchange rates at the end of periods.

Figure 3 presents the behavior of documentary bills purchased by commercial banks. They are mostly bills of exchange purchased by commercial banks from exporters.

[2] Because the amount of trade loans is much smaller than the value of exports, Figure 2 and the following figures can give a false impression that trade finance measures were much more stable than the value of trade. Attention should be focused on the movement in the ratio of trade finance to trade.

Domestic exporters are direct recipients of these credits, but because foreign importers or their banks are liable for them, they are treated as external foreign currency assets of banks. Quarterly data are collected by the Financial Supervisory Service of Korea.[3] According to Figure 3, both documentary bills purchased by banks and the value of export dropped sharply during Q4 2008 and Q1 2009. However, the ratio of bills purchased to exports remained above the downward trend line and it even peaked in Q1 2009. Again, it would be difficult to argue that the contraction of trade finance in the form of bills purchased by banks initiated the export collapse.

Figure 4. Domestic import usances and imports (in US dollar)
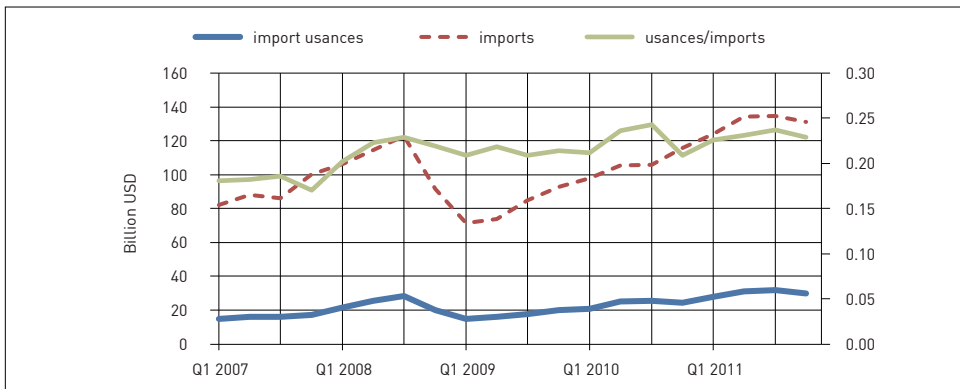
Source: Financial Supervisory Service of Korea
Observations are quarterly. Import usances and imports are shown on the left axis. The ratio of foreign trade loans to exports are shown on the right axis. The amount of bills purchased was converted to dollar value using exchange rates at the end of periods.

Figure 4 deals with the behavior of import usances. Domestic import usances are banker' usances extended by commercial banks to domestic importers. These loans are treated as domestic foreign currency assets of banks because domestic importers are liable for them in foreign currency. Quarterly data are collected by the Financial Supervisory Service of Korea.[4] Domestic import usances dropped sharply during Q4 2008 and Q1 2009. The value of imports also dropped sharply, but in this case, import usances declined faster, resulting in a slight fall of usances/imports ratio in Q4 2008 and in Q1 2009.

---

[3] The data do not include credits supplied by the local branches of foreign banks. They might have played a role.

[4] Again, the data do not include credits supplied by the local branches of foreign banks.

Afterwards, both usances and imports recovered steadily and the usances/ imports ratio remained stable. In this case, the initial drop in domestic import usances may have been a factor in causing the sharp drop in imports around the Lehman shock. However, it would be difficult to argue that the lack of import usances was a big drag against the recovery of imports during the crisis period.

Figure 5. External short-term trade credit (Accounts receivable in US dollar)
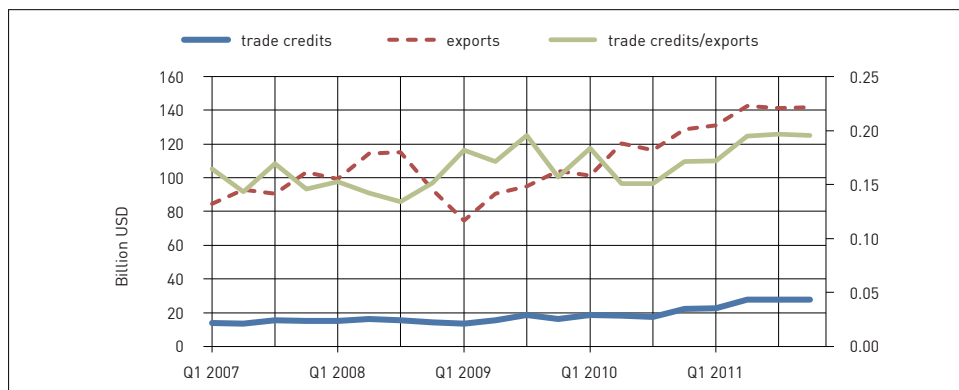
Source: Economic Statistics System, Bank of Korea
Observations are quarterly. External short-term trade credits of private firms are shown on the left axis and the ratio of the credits to exports are shown on the right axis.

Next we investigate the behavior of inter-firm trade credit collected from the Korean International Investment Position. The Bank of Korea records on the external asset side of the International Investment Position cross-border trade credit extended by domestic private firms. We look at only short-term credits. Figure 5 shows that external trade credits extended by domestic private exporters fell from Q3 2008 through Q1 2009. However, the value of exports dropped more sharply, and the ratio of trade receivables to exports increased during the crisis period.

Figure 6 investigates short-term external trade credits extended by foreign exporters to domestic importers in the form of trade payables. It is quite interesting to note that external trade payables of domestic firms increased despite the financial stress and the sharp fall of imports during Q4 2008 and Q1 2009. The ratio of trade payables to imports peaked up in Q1 2009, and was kept at a high level during the crisis period. From figures 5 and 6, it is difficult to argue that a freeze in cross-border trade credit acted as a major impediment to foreign trade expansion during the crisis period.

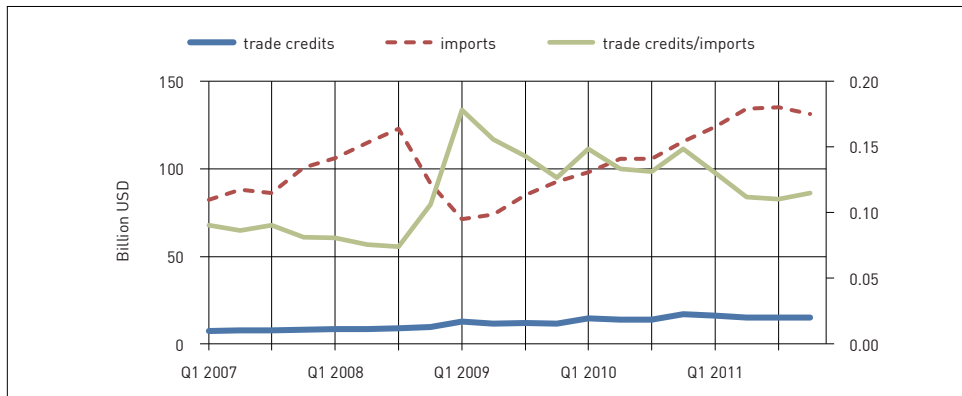Figure 6. External trade credit (Accounts payable in US dollar)

Source: Economic Statistics System, Bank of Korea
Observations are quarterly. External short-term trade credits of private firms are shown on the left axis and the ratio of the credits to imports are shown on the right axis.

The data sets above allow us to track the Korean economy both on the path of trade finance and inter-firm trade credit using official statistics. It is repeatedly observed that a measure of trade finance or trade credit sharply dropped during the crisis. However, the value of trade also declined fast such that the ratio of trade finance to trade remained stable and sometimes increased relative to the trend during the trade collapse. This evidence is consistent with the view that trade collapse caused credit contraction, through demand contraction, not the other way round. However, we need a caution in drawing this conclusion. The data are also consistent with the hypothesis that trade finance caused trade collapse, and to explain the rise in the ratio of trade finance to trade noted above, one could argue that a drop in trade finance or credit caused a proportionally larger drop in trade through a multiplier process. We need to make a more rigorous analysis, explicitly recognizing the possibility that causality can run in both directions, by conducting a time-series analysis or a micro-level study. The former approach has been taken by Hwang and Im (2013). They estimate a vector autoregression model and find that the ratio of foreign trade loans to exports and the ratio of documentary bills purchased to exports dropped when variables measuring the degree of financial stress surged during the crisis.[5]

[5] Thus their results are in conflict with Figures 2 and 3 of this paper. The difference seems to

However, they do not directly estimate the impact of finance on exports. The next section attempts to do so using micro-level data.

III. Firm-level Analysis

In this section, we test using firm-level data whether finance played an independent role in the contraction of Korean exports during the Global Financial Crisis. The econometric method that we will use is a difference-in-differences analysis at a firm level similar to the one used by Behrens et al. (2010) and Bricongne et al. (2012).

We adopt a firm-level approach for two reasons. Firstly, during the Global Financial Crisis of 2008-2009, the predominant concern of the Korean government and economists was its effects on small and medium enterprises. Korean exports are dictated by a small number of giant firms, almost all of which belong to family-controlled business groups called Chaebols. In 2007, top 10 firms exported 60 percent, and top 20 firms exported 74 percent of the total merchandise exports by listed firms in Korea. Almost all these firms belong to Chaebols specially monitored by the Korea Fair Trade Commission, have large cash reserves, and enjoy privileged access to commercial banks and bond markets.[6] If financial factors had any independent supply-side effect on the exports of Korean firms, it would show up thorough small and medium exporters. However, the effect on SMEs would be too small to be detectible by industry-level data on exports.[7] Indeed, a major response to the financial crisis of the Korean government and public financial institutions was to expand public funds for small and medium firms.[8]

---

come from the fact that they trace the dollar value of foreign trade loans, and use the 12 month average of exports instead of the current value of exports to calculate the ratio of trade finance to exports. Because foreign trade loans are won-denominated loans and the maturity of trade credit is very short, the methods used by this paper seem to be more valid, but we need to make a more careful examination to obtain a reliable conclusion.

[6] The numbers and statements are based on the WISEfn database, which compiles the data from the Korean Listed Company Association (KLCA). During the sample period, listed firms contributed on average 80 percent of total Korean exports reported by the Bank of Korea.

[7] These giant exporters depend on small and medium-sized domestic firms for the supply of parts and components, and a financial crisis can affect giant exporters through these supply chains. This is a possibility although we do not believe that it is very likely given the tight control of Chaebols over their supply chains.

[8] See Financial Services Commission (2008).

The second reason that we use firm-level data is that we can control for demand shifts and other time-varying industry-specific effects through industry-time dummies. Most of the contraction in trade finance or trade credit during the crisis is likely to be the one induced by the contraction in demand for Korean exports. A crucial step in detecting the independent role of finance on exports is to purge the influence of these demand shifts from export data. For example, in some industry-level studies, researchers find that export collapse was relatively greater in industries that are more vulnerable to financial shocks, but these industries can be exactly those where external demand dropped more. Carefully-constructed controls for industry-specific demand shocks can avoid this problem, but they are often difficult to obtain. A firm-level analysis allows us to use industry-time dummies to control for demand shifts and other time-varying industry-specific variables.

1. Data

All firm-level data that we use come from the WISEfn database, which compiles the quarterly financial statements of listed firms in Korea published by the Korean Listed Company Association (KLCA).[9] The database contains total exports and domestic sales of 1,798 listed firms, along with various income statement and balance sheet variables. For years from 2005 through 2009, on average, 62 percent of listed firms reported positive exports. It is unfortunate that the database does not break total exports by destination and by product code.

A potential problem is dealing with zeroes in exports. If we ignore them, all variations of exports at the extensive margin will be eliminated from data, and bias can be introduced in estimation. To mitigate this problem, we will use mid-point growth rates of exports as in Bricongne et al. (2012).[10]

$$g_{ikt} = \frac{x_{ikt} - x_{ikt(t-4)}}{\frac{1}{2}(x_{ikt} + x_{ik(t-4)})} \times 100 \qquad (1)$$

g_{ikt} is the year-on-year mid-point growth rate of exports by i th firm in industry

[9] We are grateful to the chairman Chulsoon Lee for allowing a discounted access to the data sets.

[10] By using this method, we can avoid the problem that arises when we take the log of zero exports. This problem is usually dealt with a Tobit or a non-linear estimation. See Head and Mayer (2013) for the recent development of these techniques. For theoretical foundation on the existence of firms with zero exports, Melitz (2003) and Chaney (2008) are standard references.

k at quarter t. x_{ikt} is the won value of exports. The only difference from the standard growth rate is that we put in the denominator the average of the past value and the current value of x instead of the past value alone. Thus the growth rate is well-defined unless both the past value and the current value of x equal zero. The mid-point growth rate moves closely with $(\log x_{ikt} - \log x_{ik(t-4)}) \times 100$ when both x_{it} and $x_{i(t-4)}$ are positive. It takes the minimum value of -200 when the value of exports drops from a positive number to zero and the maximum value of 200 when it increases from zero to a positive number.

We can classify g_{ikt} into four categories. Growth at the positive extensive margin occurs when $g_{it} = 200$, growth at the negative extensive margin when $g_{it} = -200$, growth at the positive intensive margin when g_{it} is in (0, 200), and growth at the negative intensive margin when g_{it} is in (-200, 0).

Table 1. Decomposition of mid-point export growth rates (year on year, percent)

Quarter	Extensive positive	Extensive negative	Extensive margin	Intensive positive	Intensive negative	Intensive margin	Total	Export value in KRW (BOK, goods)	KRW/ USD exchange rate
2005q1	0.02	-0.02	0.00	10.57	-5.01	5.56	5.56	-0.98	-12.75
2005q2	0.17	-0.04	0.13	7.12	-9.36	-2.24	-2.11	-3.50	-13.25
2005q3	0.07	-0.11	-0.04	7.12	-8.24	-1.12	-1.17	3.23	-10.91
2005q4	0.07	-0.03	0.04	12.12	-6.06	6.06	6.10	6.65	-5.21
2006q1	0.10	-0.06	0.05	9.90	-4.34	5.56	5.61	8.63	-4.40
2006q2	0.02	-0.15	-0.13	10.18	-3.49	6.69	6.56	8.94	-5.71
2006q3	0.04	-0.03	0.01	12.41	-4.07	8.34	8.35	10.09	-7.21
2006q4	0.04	-0.04	0.00	9.96	-5.61	4.35	4.35	2.61	-9.51
2007q1	0.03	-0.10	-0.08	11.05	-4.47	6.58	6.50	9.79	-3.95
2007q2	0.05	-0.02	0.03	13.86	-3.14	10.72	10.75	10.65	-2.23
2007q3	0.10	-0.04	0.06	14.11	-4.01	10.10	10.15	7.70	-2.81
2007q4	0.05	-0.04	0.01	16.89	-3.86	13.03	13.03	17.59	-1.90
2008q1	0.06	-0.04	0.02	21.53	-3.07	18.46	18.48	21.66	1.82
2008q2	0.09	-0.02	0.07	25.63	-1.31	24.31	24.38	36.06	9.41
2008q3	0.10	-0.04	0.06	25.90	-2.83	23.07	23.13	39.57	14.49
2008q4	0.07	-0.04	0.03	19.87	-5.85	14.02	14.05	26.65	48.03
2009q1	0.04	-0.03	0.01	12.70	-9.36	3.34	3.35	5.60	48.04
2009q2	0.07	-0.02	0.05	11.77	-11.11	0.65	0.71	-2.87	26.75
2009q3	0.10	-0.02	0.08	18.34	-8.61	9.73	9.82	-3.15	16.77
2009q4	0.03	-0.01	0.02	19.48	-8.71	10.77	10.79	-1.32	-14.25

Source: WISEfn, Bank of Korea and own calculations

The period that we examine is 20 quarters from Q1 2005 through Q4 2009.[11] We restrict our analysis to firms in manufacturing industries. Table 1 reports aggregate growth decomposed into the four margins defined above. We can see that variations at the extensive margin are very small compared to those at the intensive margin.[12] We can also note that the export growth rate of listed firms in manufacturing moves closely with the growth rate of goods exports in Korean won as reported by the Bank of Korea (their correlation equals 0.86). However, there are some notable discrepancies between the two series around the Great Financial Crisis period. The total mid-point export growth of listed

Table 2. Effects of the crisis on growth rates by industry

Industry	fixed effects
food and beverages	22.5
textile, apparel and footwear	3.5
wood, paper and printing	4.4
chemicals, chemical products and oil refinery	3.7
pharmaceuticals & medical chemicals	34.1
rubber and plastic products	15.7
non-metallic mineral products	25.4
basic metal products	-25.9
fabricated metal products	-8.6
electronic components	3.5
computers and communication equipment	14.1
medical, precision and optical instruments	12.3
electrical equipment	-8.2
domestic appliances	33.7
other machinery	-13.4
motor vehicles and parts	-38.1
ships and other transport equipment	9.6
furniture and other manufacturing	3.7

Note: The fixed effects estimated above come from a regression of mid-point growth rates on industry dummies and industry dummies interacted with the crisis dummy that takes the value of 1 in Q1 2009 and Q2 2009. They are normalized such that the weighted average equals zero.

[11] The quarterly reports of financial statements of listed firms became mandatory from 2004. At the time of writing, there were too many missing data in the financial statements for years 2010 and 2011.

[12] An issue is how to treat entries into and exits from stock exchanges by firms. Because the exports of a firm before an entry or after an exit are unobservable to us, we simply treat them as missing. We do not treat them as zeroes because many exporters were exporting before it was listed and kept on exporting after it was delisted. Thus growth at the extensive margin in our data set is mostly due to changes in the exports of small listed firms from and to zero.

firms never fell below zero during the crisis period and it recovered quickly
from Q3, 2009. In contrast, negative export growth rates were maintained from
Q2 2009 through Q4 2009 in the BOK data.

   In the analysis below, we will define the crisis period as the two quarters
from Q1 2009 through Q2 2009. During this period, the manufactured exports
of listed firms grew at near-zero rates, while in Q4 2008, Q3 2009, and Q4
2009, the growth rate was near or above 10 percent. The KLCA classifies
manufacturing firms as belonging to one of 80 industries based on the major
products of firms. The industry classification is identical to the Korean Standard
Industrial Classification at 3-digit level. For expository purpose, we regroup
them into 18 bigger industries as shown on the first column of Table 2. The
second column shows how the exports from each industry were affected during
the crisis period of Q1 2009 and Q2 2009 compared to the non-crisis period.
The numbers were obtained by estimating the industry fixed effects of the crisis
period from a regression of the mid-point export growth rates of firms on industry
dummies and industry dummies interacted with the crisis dummy that takes the
value of 1 during the crisis period.[13] The three industries that are most adversely
affected by the crisis are motor vehicles and parts, basic metal products, and
other machinery. The three that are most favorably affected are pharmaceuticals
and medical chemicals, domestic appliances, and non-metallic mineral products.

   Table 3 shows by industry the summary statistics of key financial variables
that we will use in regression. The 9 financial variables that we will investigate
are defined as follows.

$$EXTFIN \equiv (1 - \frac{\text{operating cash flows}}{\text{net increases in tangible assets}}) \times 100,$$

$$TANG \equiv \frac{\text{tangible assets}}{\text{total assets}} \times 100,$$

$$TPAY \equiv \frac{\text{trade payables}}{\text{cost of goods sold}} \times 100,$$

$$TREC \equiv \frac{\text{trade receivables}}{\text{sales}} \times 100,$$

$$INV \equiv \frac{\text{inventories}}{\text{sales}} \times 100,$$

---

[13] We estimate γ_k in the following equation: $g_{ikt} = \Sigma_k (\beta_k D_k) + \Sigma_k (\gamma_k D_k \ CRISIS_t) + \eta_{ikt}$. D_k is an
   industry dummy and $CRISIS_t$ is a dummy that takes the value of 1 in Q1 2009 and Q2 2009.

$$INTCOST \equiv \frac{\text{net interest expenses}}{\text{EBITDA}} \times 100,$$

$$STBFOR \equiv \frac{\text{short} - \text{term borrowings in foreign currencies}}{\text{sales}} \times 100,$$

$$TPAYFOR \equiv \frac{\text{trade payables in foreign currencies}}{\text{exports}} \times 100,$$

$$TRECFOR \equiv \frac{\text{trade receivables in foreign currencies}}{\text{exports}} \times 100.$$

EXTFIN is a variable that measures the degree to which a firm depends on external finance for physical investment. This measure of financial vulnerability is the most popular in the literature on finance and growth after the influential work by Rajan and Zingales (1998). We may expect that during a credit crunch, a firm that has a higher value of *EXTFIN* will experience lower export growth because of its higher financial vulnerability. Braun (2003) proposed *TANG* as a measure of secure access to external finance. We expect that a firm who has a higher value of *TANG* will suffer less in a tight credit situation because collateralized borrowing will be easier. *TPAY* measures the dependence of a firm on inter-firm credit offered by its suppliers. Fisman and Love (2003) argue that a firm that has a higher value of *TPAY* would suffer less in a tight credit market because it depends less on commercial banks for working capital finance. However, during a financial crisis, inter-firm credit can contract more than bank loans, and the opposite situation may develop. We tried alternative ways of calculating *TPAY* such as the ratio of trade payables to the stock of debt or its flow version. However, they did not work any better. In a similar concept, *TREC* can be used to measure the dependence of a firm on inter-firm credit, now the firm acting as a credit supplier. One can argue that a seller who has a higher value of *TREC* can maintain more stable flows of sales during a crisis because its customers have less need to borrow from banks. However, with the increased vulnerability of trade partners during a crisis, sellers can cut credit to their customers more sharply than bankers, and the opposite situation may apply. As in the case of *TPAY*, we tried alternative ways of calculating *TREC*, but their performances were not better. *INV* is added to check whether a firm who maintains a higher stock of inventory relative to sales suffered more during the crisis. This tendency might develop simply because firms with higher levels of inventory become more vulnerable to contraction in short-term finance as they need more working capital during production process. However, there can be more complicated reasons. Alessandria et al. (2010) and Zavacka (2012)

argue that firms with large inventories can be made more vulnerable to recessions through inventory dynamics.

In addition to these variables, we test the influence of variables that measure directly the financial vulnerability of firms. One may expect that firms who had borrowed more would suffer more during a crisis because they are more likely to be credit-rationed. There are many measures of debt reliance such as debt-to-equity ratio or interest-expense to sales ratio. Among these financial ratios, we report only results using *INTCOST*, which is the ratio of net interest expenses to EBITDA (earnings before interest, tax, depreciation and amortization). Other direct measures of debt reliance did not work any better. An attraction of our dataset is that it reports short-term borrowings and trade credits denominated in foreign currencies. *STBFOR* measures the ratio of short-term borrowings in foreign currencies to total sales. We may expect that a firm that maintains a higher value of this ratio would be hurt more by hikes in interest rates or exchange rates during a crisis. The data on trade credits denominated in foreign currencies are quite valuable as data on cross-border trade credit at firm-level are very rare. *TPAYFOR* is the ratio of trade credit payable in foreign currencies to exports. Using imports rather than exports in the denominator might be more appropriate, but imports data were not available. However, the ratio of cross-border trade payables to exports can be a more relevant measure for our purpose because we are investigating whether exporters that are dependent on trade credit for importing intermediates to be processed into their exports suffer more during a financial crisis. *TRECFOR* is the ratio of trade credit receivable in foreign currencies to exports. Again we cannot determine a priori whether exporters that depend more on international trade credit would hurt more or less during a crisis.

Table 3 reports for each of 18 industries the medians and the standard deviations of mid-point export growth rates and the financial ratios of firms to be included in regressions. We calculated the sample-period averages of these variables for each firm, and then obtained the median and the standard deviation of each variable in each industry. For each industry, the upper row shows the medians and the lower row (in parentheses) shows the standard deviations. On the second column, we report export growth rates. The average of industry medians is 6.1 per cent and the standard deviations are quite large. On the third column, we see that the standard deviations of *EXTFIN* are extremely large in most industries, and this occurs mainly because fixed investments are near zero for many firms. This observation casts doubt about the usefulness

of *EXTFIN* data at firm-level. We find from Table 3 that *INTCOST*, *TPAYFOR* and *TRECFOR* also have high standard deviations relative to medians, but to a far less degree than *EXTFIN*.

Table 3. Medians and standard deviations of key variables by industry

Industry	GROWTH MDP	EXTFIN	TANG	TPAY	TREC	INV	INTCOST	STBFOR	TPAYFOR	TRECFOR
food and beverages	7.9 (69.6)	-87.4 (1248.4)	38.5 (15.0)	11.2 (7.1)	11.7 (7.6)	8.2 (12.8)	3.1 (101.0)	0.0 (22.9)	0.0 (9.7)	3.8 (15.3)
textile, apparel and footwear	-4.7 (79.4)	-9.9 (979.4)	33.3 (17.4)	7.9 (9.9)	14.3 (7.9)	20.8 (10.6)	7.0 (349.9)	0.0 (14.7)	2.4 (55.8)	5.4 (32.9)
wood, paper and printing	-2.1 (73.6)	-47.4 (1305.6)	51.7 (16.9)	6.0 (4.9)	16.7 (6.1)	10.9 (7.3)	12.2 (87.6)	3.4 (10.5)	0.2 (19.1)	3.0 (8.2)
chemicals, chemical products and oil refinery	7.2 (57.1)	-71.2 (603.3)	40.6 (16.0)	9.8 (5.9)	15.7 (7.8)	11.0 (8.6)	3.5 (70.0)	0.0 (7.3)	3.5 (95.0)	6.5 (12.0)
pharmaceuticals & medical chemicals	12.6 (85.0)	-61.1 (355.9)	28.4 (11.9)	11.2 (7.7)	38.0 (18.1)	14.1 (8.0)	1.2 (102.1)	0.0 (2.5)	3.0 (193.0)	5.0 (79.1)
rubber and plastic products	7.7 (52.4)	1.4 (320.8)	37.1 (14.2)	9.3 (4.3)	20.1 (9.4)	9.0 (7.3)	0.0 (33.6)	0.0 (7.2)	0.9 (9.0)	8.0 (9.4)
non-metallic mineral products	6.0 (77.8)	-83.2 (331.8)	38.1 (14.7)	10.9 (5.5)	22.7 (8.5)	13.0 (10.0)	7.6 (38.6)	0.0 (4.5)	1.7 (31.7)	4.9 (91.4)
basic metal products	4.3 (75.4)	27.6 (455.3)	39.1 (14.6)	7.8 (6.5)	15.3 (7.3)	14.1 (8.2)	11.7 (25.6)	2.1 (17.2)	0.5 (31.5)	5.0 (11.2)
fabricated metal products	12.5 (88.4)	24.4 (2089.4)	33.9 (11.3)	14.2 (5.5)	19.2 (6.2)	13.0 (10.6)	7.1 (47.0)	0.0 (9.6)	0.0 (7.8)	9.5 (12.4)
electronic components	4.4 (75.7)	26.6 (1673.8)	33.0 (16.5)	9.6 (5.8)	16.7 (9.8)	12.0 (11.0)	1.9 (125.1)	0.0 (7.6)	2.9 (27.2)	12.9 (55.5)
computers and communication equipment	-4.6 (93.2)	-71.3 (2678.8)	19.1 (13.3)	11.4 (7.1)	19.0 (11.7)	12.9 (10.5)	-0.8 (941.5)	0.0 (9.9)	2.6 (105.6)	12.8 (91.9)
medical, precision and optical instruments	7.0 (86.7)	15.8 (315.3)	22.8 (14.9)	13.7 (6.4)	23.8 (14.2)	13.3 (9.9)	-2.7 (314.8)	0.0 (7.4)	0.8 (40.2)	16.4 (42.7)

Table 3. Continued

Industry	GROWTH MDP	EXTFIN	TANG	TPAY	TREC	INV	INTCOST	STBFOR	TPAYFOR	TRECFOR
electrical equipment	3.4 (86.4)	19.9 (1507.8)	29.4 (13.7)	12.0 (6.2)	19.1 (8.5)	11.7 (6.6)	4.1 (241.0)	0.0 (6.4)	1.8 (144.6)	11.0 (15.7)
domestic appliances	17.7 (69.1)	-3.2 (324.4)	28.8 (13.3)	14.8 (8.9)	18.9 (7.0)	8.8 (12.1)	-3.2 (20.6)	0.0 (2.0)	0.9 (3.8)	9.8 (10.8)
other machinery	9.0 (91.8)	-23.9 (708.1)	25.1 (13.9)	15.3 (8.4)	24.6 (12.3)	15.6 (11.6)	1.3 (91.5)	0.0 (6.9)	0.6 (88.3)	16.3 (20.1)
motor vehicles and parts	6.8 (57.1)	-20.2 (417.8)	39.2 (13.7)	16.3 (7.9)	17.4 (6.4)	5.4 (6.8)	3.7 (59.1)	0.0 (3.9)	0.0 (7.9)	2.9 (14.9)
ships and other transport equipment	24.0 (53.2)	-154.5 (315.2)	38.7 (13.5)	11.2 (5.6)	21.3 (8.4)	5.7 (3.3)	-6.2 (69.1)	0.0 (9.7)	0.3 (0.5)	7.2 (11.7)
furniture and other manufacturing	-9.7 (84.6)	-48.0 (284.5)	34.7 (15.8)	12.2 (6.4)	17.6 (14.0)	13.1 (14.1)	-1.4 (33.9)	0.0 (6.2)	1.6 (38.5)	8.8 (17.2)
Average median Average standard deviation	6.1 (75.4)	-31.4 (884.2)	34.0 (14.5)	11.4 (6.7)	19.6 (9.5)	11.8 (9.4)	2.8 (152.9)	0.3 (8.7)	1.3 (50.5)	8.3 (30.7)

Source: WISEfn and own calculations.

Note: For each industry, the numbers on the upper row are the medians of financial variables, and those on the lower row in the parentheses are the standard deviations. In each industry, the median and the standard deviation for each variable are calculated from five-year averages (2005-2009) of the variable for firms included in regressions. Average median is equal to the average of medians across industries. Average standard deviation is the average of standard deviations across industries.

2. Estimation

For our benchmark regressions, we will use the following specification.

$$g_{ikt} = \beta_0 + \beta_1 \, VAR_{ikt} + \beta_2 \, VAR_{ikt} * CRISIS_t + \beta_3 \ln LABORPROD_{ikt} + \beta_4 \ln EXPSHARE_{ikt} + v_{kt} + \varepsilon_{ikt}.$$

(2)

VAR is one of the nine financial ratios defined above. We add to this list of financial ratios another variable *ASSET*, which is a dummy that takes the value of 1 when a firm is in the bottom quintile of its industry in terms of asset size. The small-firm dummy is added to test whether small firms were more adversely affected during the financial crisis.[14] *CRISIS* is a dummy that equals 1 if *t* is in the crisis period. $\ln LABORPROD$ is the natural log of labor productivity calculated as the ratio of value-added to the number of employees. $\ln EXPSHARE$ is the natural log of a firm's export share in its industry.

Note that (2) is written in the form of a difference-in-differences model.[15] What we aim to test here is whether firms who had higher values of *VAR* compared to other firms in the same industry experienced larger drops in export growth during the crisis period.[16] *VAR* is included in the regression equation because firms with difference values of *VAR* were growing at different rates during the non-crisis period, and what we want to compare across firms is the difference between the growth rate during the crisis period and that during the non-crisis period. What we are most interested in is the sign of β_2. A negative (positive) β_2 implies that firms with higher values of *VAR* experienced lager (smaller) drops in export growth during the crisis. In this way, we can infer whether the financial characteristics of firms captured by *VAR* exerted a negative (positive) effect on exporting during the crisis.

A potential problem in applying the difference-in-differences method to a firm-level analysis is that financial factors represented by *VAR* might be correlated with the error term ε. To mitigate the endogeneity problem, we employ two methods. Firstly, we use the past values of *VAR*s in regressions. For example, *EXTFIN*$_{ikt}$ for quarter *t* in year *s* is calculated by the three-year average of *EXTFIN* from years (*s*-4) through (*s*-2).[17] Other *VAR*s are calculated in the

---

[14] Thus our definition of small firms differs from the official one, which treats as small and medium sized firms those that have less than 300 employees or equity value below 8 billion won.

[15] The variable *CRISIS* was not included in the regression as it is subsumed by v_{kt}, industry-time dummies.

[16] We can write a simple model based on monopolistic competition in which the exports of a firm with higher dependence on finance fall more during the crisis if they have to pay higher interests or get more credit-constrained. For theoretical foundation on the link between finance and international trade, see, for example, Ahn (2011), Antràs and Foley (2011), and Chaney (2013).

[17] For each firm, we calculated the three-year averages of numerators and denominators of *VAR*, and then took a ratio between them. Firms usually are required to submit the financial statements for the past three years when they apply for bank loans. The value for year (s-1) was not used because exports in that year is used to calculate export growth rates for quarters in year s. Annual values were used to increase the availability of the data.

same way. Secondly, we add on the right-hand side ln $LABORPROD$ to control for the competitiveness of firms. We may conjecture that firms with higher productivity would have higher export growth. We also include ln $EXPSHARE$, following Rajan and Zingales (1998). This variable is for capturing the convergence dynamics of firms: young and small firms may grow faster than mature firms, or firms who experienced unusual adverse shocks may recover and grow faster in later periods. Again, we use the past values of these variables in regressions. These two variables could be interacted with the crisis dummy, but we found that the interaction terms are not significant and do not alter our main results.

v_{kt} are industry-quarter dummies capturing fixed effects that vary across industries and quarters. They capture variations in price deflators and exchange rates that change with (k, t). However, this dummy variable serves a more important purpose. v_{kt} are included to control for demand shifts that vary across time and industries. By doing this, we eliminate the influence of industry-level demand shocks on firm-level exports, and this is a crucial step for our analysis, which tries to separate out the supply-side influence of finance from demand shifts. In our benchmark regressions, we use robust standard errors clustered by industries because export shocks faced by firms in the same industry are likely to be contemporaneously correlated.

Table 4 reports the results of our benchmark regressions. The dependent variable is the mid-point growth rates of firms. Across all regressions, we find that the effects of ln $LABORPROD$ and ln $EXPSHARE$ on export growth are highly significant. A 1 percent increase in labor productivity raises the export growth rate by about 0.1 percentage point. We also find that there is a tendency for convergence. A 1 percent increase in the export share tends to lower the export growth rate by about 0.03 percentage point. In the below, we will not further mention about these two variables as the effects of these two variables are consistently strong across all regressions.

Table 4. Effects of financial variables on export growth

	EXTFIN (1)	TANG (2)	TPAY (3)	TREC (4)	INV (5)	INTCOST (6)	STBFOR (7)	TPAYFOR (8)	TRECFOR (9)	ASSET (10)
VAR	0.000 (0.16)	0.198** (2.27)	0.078 (0.55)	-0.432 (-0.33)	-0.131 (-0.89)	-0.001 (-0.96)	0.450*** (4.36)	0.023*** (2.74)	0.081*** (4.09)	-6.555 (-1.42)
VAR * CRISIS	0.005*** (3.46)	0.066 (0.27)	0.542 (0.99)	0.452 (1.40)	-0.270 (-0.87)	-0.018 (-1.40)	-0.023 (-0.07)	-0.001 (-0.02)	-0.088 (-1.10)	4.672 (0.40)
ln LABORPROD	10.079*** (3.39)	10.149*** (3.60)	9.841*** (3.51)	10.108*** (3.56)	9.348*** (3.16)	9.958*** (3.53)	9.844*** (3.43)	9.164*** (3.08)	9.549*** (3.20)	9.306*** (3.22)
ln EXPSHARE	-2.750*** (-6.29)	-3.083*** (-6.69)	-2.824*** (-6.29)	-2.954*** (-6.05)	-2.857*** (-6.27)	-2.948*** (-6.74)	-2.883*** (-6.52)	-1.718*** (-3.12)	-1.631*** (-2.95)	-3.141*** (-8.15)
Industry-Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	9,772	13,148	13,093	13,146	13,077	13,148	13,148	12,969	12,969	13,148
R^2	0.156	0.130	0.129	0.129	0.130	0.129	0.132	0.122	0.124	0.130

Note: The dependent variable is *GROWTHMDP*. Each column reports regression results when VAR is equal to the financial variable on the top row. *CRISIS* is a dummy variable that takes the value of 1 in Q1 2009 and Q2 2009. *ASSET* is a dummy that takes the value of 1 when a firm belongs to the bottom 20 percent in asset size. The numbers in the parentheses are *t*-ratios calculated using robust standard errors (clustering by industries). Constants are not reported.
***: significant at 1 percent, **: significant at 5 percent, *: significant at 10 percent

Of the ten variables under investigation, only one variable has significant effects on export contraction during the crisis period: *EXTFIN*. A higher dependence on external finance in investment increased export growth during the crisis, and the effect is significant at 1 percent. This result is not in line with studies that use data from other countries, which tend to find that industries or firms with higher dependence on external funds for investment suffer more during a financial crisis. Our puzzling result might be explained by the hypothesis that exporters that executed more aggressive investment strategies before the crisis grew more during the crisis, but it could have been caused by data problems.

All other variables are found insignificant. The availability of tangible assets for collateral loans (*TANG*), total (domestic plus foreign) trade credit received and extended (*TPAY* and *TREC*), inventories (*INV*), interest expenses (*INTCOST*), short-term borrowing in foreign currencies (*STBFOR*), and trade payables and receivables in foreign currencies (*TPATFOR* and *TRECFOR*) all had insignificant effects on export contraction. It is also interesting to note that smaller firms did not seem to experience additional contraction during the crisis. Our *ASSET* dummy is found to be insignificant. We find the same result whether we use different percentiles to define small firms or use the number of employees instead of assets to define smallness. This finding runs counter to the expectation of many observers who believe that small firms are discriminated in the Korean financial markets.

We investigate further into the experience of small firms during the crisis because this is an important concern of policy makers. For this purpose, we regress export growth on financial ratios interacted with the asset dummy:

$$g_{ikt} = \gamma_0 + \gamma_1 \, VAR_{ikt} + \gamma_2 \, VAR_{ikt} * CRISIS_t + \gamma_3 \, VAR_{ikt} * ASSET_{ikt} + \\ \gamma_4 VAR_{ikt} * ASSET_{ikt} * CRISIS_t + \gamma_5 \ln LABORPROD_{ikt} + \\ \gamma_6 \ln EXPSHARE_{ikt} + v_{kt} + \varepsilon_{ikt}.$$

$$(3)$$

Table 5. Effects of financial variables interacted with an asset-size dummy

	EXTFIN	TANG	TPAY	TREC	INV	INTCOST	STBFOR	TPAYFOR	TRECFOR
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
VAR	-0.001 (-1.23)	0.208** (2.44)	0.073 (0.51)	-0.018 (-0.15)	-0.102 (-0.64)	-0.001 (-0.92)	0.488*** (5.24)	0.024*** (2.92)	0.088*** (4.31)
VAR * CRISIS	0.004 (0.65)	0.064 (0.26)	0.506 (0.90)	0.422 (1.25)	-0.271 (-0.81)	-0.032*** (-2.37)	0.201 (1.02)	0.009 (0.26)	0.049 (0.82)
VAR * ASSET	0.003 (0.94)	-0.183* (-1.71)	0.077 (0.16)	-0.161 (-0.73)	-0.342 (-0.41)	0.012 (0.22)	-0.312 (-0.76)	-0.019 (-0.89)	-0.056 (-1.19)
VAR * ASSET * CRISIS	-0.001 (-0.18)	0.102 (0.38)	0.404 (0.45)	0.145 (0.34)	0.089 (0.16)	0.074 (1.25)	-0.341 (-0.87)	-0.299*** (-2.93)	-0.251*** (-3.47)
ln LABORPROD	10.023*** (3.43)	9.556*** (3.35)	9.973*** (3.44)	9.832*** (3.36)	8.863*** (2.96)	9.958*** (3.53)	9.656*** (3.36)	9.181*** (3.08)	9.553*** (3.24)
ln EXPSHARE	-2.747*** (-6.24)	-3.235*** (-7.68)	-2.770*** (-5.94)	-3.054*** (-6.39)	-2.965*** (-6.91)	-2.943*** (-6.74)	-2.908*** (-6.85)	-1.761*** (-3.20)	-1.697*** (-3.08)
Industry-Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	9,772	13,148	13,093	13,146	13,077	13,148	13,148	12,969	12,969
R²	0.157	0.131	0.129	0.130	0.131	0.129	0.132	0.123	0.125

Note: The dependent variable is *GROWTHMDP*. Each column reports regression results when *VAR* is equal to the financial variable on the top row. *CRISIS* is a dummy variable that takes the value of 1 in Q1 2009 and Q2 2009. *ASSET* is a dummy that takes the value of 1 when the firm belongs to the bottom 20 percent in asset size. The numbers in the parentheses are *t*-ratios calculated using robust standard errors (clustering by industries). Constants are not reported.

***: significant at 1 percent, **: significant at 5 percent, *: significant at 10 percent

VAR and *VAR * ASSET* measure the influence of a financial variable *VAR* on the export growth of non-small firms and small firms, respectively, for normal periods. As in the previous regression, *VAR * CRISIS* is included to see if *VAR* intensified export contraction during the crisis, in this case, for non-small firms. Here we are interested in the sign of γ_4 on *VAR * ASSET * CRISIS*. A negative value implies that *VAR* caused larger export contraction during the crisis for small firms than for non-small firms. In other words, we are asking whether smallness increased export contraction through its interaction with the financial factor represented by *VAR*. In Table 5, we can see that smallness significantly intensified export contraction through its interactions with two variables: *TPAYFOR* and *TRECFOR*. Regressions (18) and (19) report that non-small firms who use more of international trade payables or receivables did not experience any additional export contraction during the crisis. (The coefficient on *VAR * CRISIS* is near zero and insignificant.) However, small firms that are more dependent on international trade payables or international trade receivables experienced more export contraction during the crisis. The effects are large and highly significant. From the coefficients on *VAR * ASSET * CRISIS*, we can infer that a 10 percentage point increase in *TPAYFOR* causes a 2.99 percentage point drop of export growth for small firms, while a 10 percentage point increase

Table 6. Effects of financial variables on export growth: robustness

	EXTFIN		
	(20) Effects on growth (clustering by firms)	(21) Effects on net growth (clustering by industries)	(22) Effects on net growth (clustering by firms)
VAR	0.000 (0.15)	-0.000 (-0.33)	-0.000 (-0.75)
VAR * CRISIS	0.005*** (2.57)	0.004*** (3.35)	0.004** (2.28)
ln LABORPROD	10.079*** (3.19)	9.387*** (3.65)	9.387*** (3.08)
ln EXPSHARE	-2.750*** (-4.42)	-2.979*** (-5.52)	-2.658*** (-4.74)
Industry-Quarter fixed effects	Yes	Yes	Yes
Obs.	9,772	9,541	9,541
R^2	0.156	0.136	0.136

Note: net growth defined as the mid-point growth rate of exports minus the mid-point growth rate of domestic sales. *CRISIS* is a dummy variable that takes the value of 1 in Q1 2009 and Q2 2009. Constants are not reported.

in *TRECFOR* leads to a 2.51 percentage point drop of export growth for small firms. The other variables do not seem to have any influence on the export experience of small firms.

   In the remainder of this section, we do some robustness checks for our benchmark regressions. In Table 6, we check whether *EXTFIN*, the only variable that we found significant in affecting export growth by itself, is robust, using three different estimation techniques. In regression (20), we use the same specification, but cluster standard errors by firms, instead of industries. This method is more reliable if errors are serially correlated. We still find that *EXTFIN* has a significant and positive effect on export growth. In the next regression, we regress net export growth on *EXTFIN*, along with controls. Here net export growth is defined as the mid-point growth rate of exports minus the mid-point growth rate of domestic sales. This check is important because what the literature on trade finance and export collapse tries to answer is the question whether

Table 7. Effects of financial variables interacted with an asset-size dummy: robustness

	TPAYFOR			TRECFOR		
	(23) Effects on growth (clustering by firms)	(24) Effects on net growth (clustering by industries)	(25) Effects on net growth (clustering by firms)	(26) Effects on growth (Clustering by firms)	(27) Effects on net growth (clustering by industries)	(28) Effects on net growth (clustering by firms)
VAR	0.024* (1.76)	0.026** (2.50)	0.026** (2.00)	0.088*** (3.15)	0.0783* (1.82)	0.0783** (2.10)
VAR * CRISIS	0.009 (0.20)	0.048 (1.65)	0.048 (1.18)	0.049 (0.54)	0.069 (0.76)	0.069 (0.71)
VAR * ASSET	-0.019 (-0.76)	-0.011 (-0.42)	-0.011 (-0.37)	-0.056 (-1.27)	-0.009 (-0.17)	-0.009 (-0.18)
VAR * ASSET * CRISIS	-0.299*** (-2.79)	-0.326*** (-3.45)	-0.326*** (-3.28)	-0.251*** (-2.22)	-0.433*** (-5.09)	-0.433*** (-3.40)
ln LABORPROD	9.181*** (3.38)	8.920** (2.50)	8.920*** (2.83)	9.553*** (3.58)	9.528*** (2.78)	9.528*** (3.11)
ln EXPSHARE	-1.761*** (-2.70)	-2.038*** (-3.20)	-2.038*** (-2.85)	-1.697*** (-2.70)	-2.096*** (-3.28)	-2.096*** (-3.03)
Industry-Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	12,969	12,635	12,635	12,969	12,635	12,635
R^2	0.123	0.112	0.112	0.125	0.114	0.114

Note: Net growth defined as the mid-point growth rate of exports minus the mid-point growth rate of domestic sales. *CRISIS* is a dummy variable that takes the value of 1 in Q1 2009 and Q2 2009. Constants are not reported.

trade finance can help explaining the Great Trade Collapse, namely, trade contraction much larger than GDP contraction during the Global Financial Crisis. If one of our financial variables contributes toward answering this question, it should be found to have reduced exports proportionally more than domestic sales. In regression (21), we find that a higher values of *EXTFIN* is associated with a lower drop of the ratio of exports to domestic sales. In regression (22), we find a similar result when errors are clustered by firms. *EXTFIN* had a positive effect both on export and on exports/sales ratio.

In Table 7, we do similar robustness checks for equation (3), by which we estimate the effect of smallness interacted with financial ratios. In regressions (23) through (28), we find that *TPAYFOR* and *TPAYREC* interacted with smallness remain highly significant across three different estimation methods. During the crisis, small firms that are more dependent on cross-border trade payables or receivables experienced more contraction in export growth and in the growth of exports/sales ratio, regardless of clustering methods. In addition, though not reported, we ran regressions using a broader industry classification of 18 industries, but we obtained similar results.

To quantity the effects through international trade credit markets, we estimate the joint effects of *TPAYFOR* and *TPAYREC* using equation (4):

$$g_{ikt} = \delta_0 + \delta_1\ TPAYFOR_{ikt} + \delta_2 TPAYFOR_{ikt} * CRISIS_t + \delta_3\ TPAYFOR_{ikt} * \\ ASSET_{ikt} + \delta_4\ TPAYFOR_{ikt} * ASSET_{ikt} * CRISIS_t + \delta_5\ TPAYREC_{ikt} + \\ \delta_6\ TPAYREC_{ikt} * CRISIS_t + \delta_7\ TPAYREC_{ikt} * ASSET_{ikt} + \\ \delta_8\ TPAYREC_{ikt} * ASSET_{ikt} * CRISIS_t + \gamma_9 \ln LABORPROD_{ikt} + \gamma_{10} \\ \ln EXPSHARE_{ikt} + v_{kt} + \varepsilon_{ikt}.$$

(4)

The estimated values for δ_4 and δ_8 are -0.26 and -0.23, respectively, and both of them are significant at 1%. The coefficients for *TPAYFOR * CRISIS* and *TRECFOR * CRISIS* are very small and insignificant, and therefore can be ignored. From these estimates, we can infer that the export growth rate of each firm was lowered by $(0.26\,TPAYFOR_{ikt} * ASSET_{ikt} + 0.23\,TPAYREC_{ikt} * ASSET_{ikt})$ during the crisis period because of the tightening of international trade credit for small firms. By calculating the weighted average of these numbers, where the weight is the export share of each firm, we can estimate how much the growth rate of the total exports of listed firms was lowered by tightened international trade credit. We find that the export growth rate was lowered by

0.008 percentage point in Q1, 2009 and by 0.05 percentage point in Q2, 2009. Some of small firms experienced serious squeeze, but they were too small to affect aggregate exports.

IV. Conclusion

Official data on trade finance are valuable because they are rare. Aggregate data on various measures of trade finance are available in Korea, and we made a casual observation on their behavior during the financial crisis of 2008-09. We find that these data sets do not convincingly support the view that trade finance played an active role in causing trade collapse.

The results on our firm-level analysis mostly confirm this impression. Our regression analysis suggests that the financial vulnerability of firms, measured by various financial ratios, did not contribute to export contraction that firms experienced during the financial crisis. This observation applies even to smaller firms, who are usually thought financially more vulnerable. However, we find that small exporters that depend heavily on cross-border trade credit to import intermediates or export their products did suffer more drops in export growth, while cross-border trade credit markets did not seem to tighten for non-small firms. Our finding implies that the export contraction of small exporters during a financial crisis can be amplified, not through the usual channel of tightened bank loans, but by the contraction of international inter-firm trade credits. Policy makers should take this possibility into mind when they design policies for assisting small exporters.

References

Ahn, J. 2011. "A Theory of Domestic and International Trade Finance," IMF Working Paper 11/262.

Alessandria, G., Kaboski, J. P. and V. Midrigan. 2010. "The Great Trade Collapse of 2008-09: An Inventory Adjustment?," *IMF Economic Review*, vol. 58, no. 2, pp. 254-294.

Amiti, M. and D. Weinstein. 2011. "Export and Financial shocks," *Quarterly Journal of Economics*, vol. 126, issue 4, pp. 1841-1877.

Antràs, P. and F. Foley. 2011. "Poultry in Motion: A Study of International Trade Finance Practices," NBER Working Paper No. 17091.

Asmundson, I., Dorsey, T., Khachatryan, A., Niculcea, I. and M. Saito. 2011. "Trade and Trade Finance in the 2008-2009 Financial Crisis," IMF Working Paper 11/16.

Braun, M. 2003. "Financial Contractibility and Asset Hardness," mimeo, Harvard University.

Behrens, K., Corcos, G. and G. Mion. 2010. "Trade Crisis? What Trade Crisis?," CEPR Discussion Paper No. 7956.

Bricongne, J. C., Fontagné, L., Gaulier, G., Taglioni, D. and V. Vicard. 2012. "Firms and the Global Crisis: French Exports in the Turmoil," *Journal of International Economics*, vol. 87, issue 1, pp. 134-146.

Chauffour, J. and M. Malouche. 2011. "Trade Finance during the Great Trade Collapse," Economic Premise Note Series, No. 66. World Bank.

Chaney, T. 2008. "Distorted Gravity: The Intensive and Extensive Margins of International Trade," *American Economic Review*, vol. 98, no. 4, pp. 1707-1721.

Chaney, T. 2013. "Liquidity Constrained Exporters," NBER Working Paper No. 19170.

Chor, D. and K. Manova. 2012. "Off the Cliff and Back? Credit Conditions and International Trade during the Global Financial Crisis," *Journal of International Economics*, vol. 87, issue 1, pp. 117-133.

Committee on the Global Financial System. 2014. Trade Finance: Developments and Issues, CGFS Papers No. 50. Bank of International Settlemants.

Eaton, J., Kortum, S. Neiman, B. and J. Romalis. 2010. "Trade and the Global Recession," University of Chicago, Mimeo.

Financial Services Commission. 2008. "Measures for Supplying Foreign Exchange Liquidity for Export and Import Finance," press release, November 13. (in Korean)

Fisman, R. and I. Love. 2003. "Trade Credit, Financial Intermediary Development, and Industry Growth," *Journal of Finance*, vol. 58, no. 1, pp. 353-374.

Head, K. and T. Mayer. 2013. "Gravity Equations: Workhorse, Toolkit, and Cookbook," CEPR Discussion Papers 9322.

Iacovone, L. and V. Zavacka. 2009. "Banking Crises and Exports: Lessons from the Past," Policy Research Working Paper 5016, World Bank.

International Monetary Fund. 2010. World Economic Outlook, April.

Levchenko, A. A., Lewis, L. T. and L. L. Tesar. 2010. "The Collapse of International Trade during the 2008-2009 Crisis: In Search of the Smoking Gun," *IMF Economic Review*, vol. 58, no 2, pp. 214-253.

Melitz, M. J. 2003. "The Impact of Trade on Intra-Industry Reallocations and

Aggregate Industry Productivity," *Econometrica*, vol. 71, no. 6, pp. 1695-1725.

Minetti, R. and S. Zhu. 2011. "Credit Constraints and Firm Export: Microeconomic Evidence from Italy," *Journal of International Economics*, vol. 83, issue 2, pp. 109-125.

Rajan, R. G. and L. Zingales. 1998. "Financial Dependence and Growth," *American Economic Review*, vol. 88, no. 3, pp. 559-586.

Hwang, S. and H. Im. 2013. "Financial Shocks and Trade Finance: Evidence from Korea," *Economics Letters*, vol. 120, issue 1, pp. 104-107.

Zavacka, V. 2012. "The Bullwhip Effect and the Great Trade Collapse," EBRD Working Paper No. 148.

About the Author

E. Young Song is Professor at the Department of Economics, Sogang University. He holds a Ph.D. in Economics from Harvard University. He was an assistant professor at Vanderbilt University, USA. He has published papers on international trade and economic growth in international journals including International Economic Review, Journal of International Economics, Canadian Journal of Economics, Journal of Economic Dynamics and Control, and Review of International Economics.