Asian
Growth Research
Institute

調査報告書 17－04

Crisis, Financial Costs, and Export Margins: Evidence from China

平成 30（2018）年 3 月

公益財団法人　アジア成長研究所

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Project Summary

This research project is designed to examine the effects of demand shock on margins of trade. The 2008–2009 economic crisis hits China's exports severely. However, during this downturn, the extensive margins of exports from China increased. That is, the number of firms participating in the export market rises after the crisis. This observation is in sharp contrast with results found in the existing literature based on the United States market reactions. In order to explain this phenomenon, we extend the Melitz (2003) model by allowing exporting firms to depend on external finance to cover their costs. The model shows that the exporting revenue of each firm (i.e. intensive margin) and the number of exporting firms (i.e. extensive margin) are both negatively affected by the weak foreign demand and benefit from the counter-measures taken by exporting countries, such as quantity easing policy. However, the extensive margin is more sensitive to the change on interest rates than the intensive margin. In other words, the model predicts a decrease in the intensive margin and an increase in the extensive margin at the same time when changes in demand and interest rates fall in a well-behaved interval. Our empirical results from China's firm-level data have provided good evidence for the predictions. This is a joint research project with Bo Chen, Ran Jing and Junjie Hong.

Acknowledgements: We thank Marc Melitz, John Whalley, Zhihong Yu, Larry Qiu, Yi Lu, Jiandong Ju, Holger Breinlich, Hong Ma, Zhi Yu, and Rudai Yang for their valuable comments. However, the authors are solely responsible for all remaining errors and opinions expressed in this paper and Xiaonan Sun is solely responsible for the content of the project summary.

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Bo Chen, Ran Jing, Junjie Hong and Xiaonan Sun

1. Introduction

The 2008–2009 economic crisis severely hits international trade. World trade dropped 12% in the volume in 2009.[1] Being closely integrated into the global economy, China's exports were badly hit during this recession. China's total export value dropped around 15% in value in 2009 relative to 2008.[2] Figure 1 depicts China's monthly exports from January 2008 to November 2010. It is clear that China's exports keep decreasing since September 2008 and touch the bottom in February 2009.

Figure 1: China's Exports from January 2007 to November 2010

With Dixit-Stiglitz type of monopolistic models and highly disaggregated data, economists can convincingly investigate separately the results of intensive and extensive margin under various shocks. For example, product churning in business cycles (which include recessions) has received wide attention recently. Bernard, Redding, and Schott (2010) document the

[1] WTO Press Release 598, 26 March 2010. http://www.wto.org/english/news e/pres10 e/pr598 e.htm.

[2] It is based on the authors' calculation.

contribution of product creation and destruction to US aggregate output. Broda andWeinstein (2010) use highly disaggregated barcode to show that product creation is strongly procyclical. Bilbiie, Ghironi, and Melitz (2007) provide a theoretical interpretation that relates the product variety with business cycles. However, few literatures pay attention to the impacts on exports margins during business cycles. Particularly, it is overlooked that economic crisis may hit intensive and extensive margin of exports in different ways.

We have done the following work in this paper. First, we extend Melitz (2003) model by allowing exporting firms to depend on external finance to cover their fixed costs. The model shows that though the exporting revenue of each firm (i.e. the intensive margin) unambiguously drops due to weaker foreign demand, the number of exporting firms (i.e. the extensive margin) may increase due to counter-measures taken by exporting countries, such as decrease interest rates. Next, we measure the size of contraction at different aggregation levels and decompose China's exports by intensive and extensive margins. The intensive margin is defined as the average export value for each country-product combination, while the extensive margin refers to the number of destination countries and the average number of products to each destination market. Following Bernard, Jensen, Redding, and Schott (2009) and Schott (2009), by looking at the main driving margin of the total collapse, the contraction of China's exports is mainly driven by the large decreases on intensive margins. The extensive margins of exports in fact increase at both aggregated and disaggregated levels. Among different types of goods investigated, only homogeneous goods have their extensive margin decrease during the recession; for China's exports to different markets, only EU and United States have their extensive margins drop during the recession. In addition, they both decrease by limited amounts. The substantial decreases in China's exports during the recession are mainly driven by the drop in the average exports value of the country-product combinations exported continuously.

This finding is consistent with the ones that Behrens, Corcos, and Mion (2010) find for Belgium firms and Schott (2009) obtains for US trade in the 2008–2009 crisis, and Bernard et al. (2009) observe for US trade in the 1997 Asian financial crisis.

The remainder of the paper proceeds as follows. Section 2 reviews the literature about impacts of financial crisis and firm reactions through trade. Section 3 decomposes the changes in China's exports along different margins. Section 4 provides theoretical discussion on how economic crisis hits exports by extending Melitz (2003) model to considering government's counter-measures of reducing interest rate. Section 5 provides empirical evidence for the hypothesis. The last section concludes.

2. Literature Review

This paper is related to the fast-growing literature on the trade collapse during economic crisis. Because the 2008–2009 trade collapse was "sudden, severe, and synchronised" (Baldwin, 2009), a number of hypotheses have been proposed to explain the causes of this collapse and why the trade flows were much more volatile than GDP.

The main driving forces could be summarized as the reasons on both demand and supply sides. On the demand side, Eaton, Kortum, Neiman, and Romalis (2011) use elaborate general equilibrium model and suggest that the collapse in trade was primarily by a synchronized demand-side shocks. Baldwin (2009) includes a large survey of the empirical studies of the trade collapse and concludes in favor of demand-side explanations. As mentioned by Ahn, Amiti, and Weinstein (2011), so far there has been little doubt that demand plays a predominant part in the recent decline in world trade.

Meanwhile increasing attention has been put on the dramatic trade credit crunch as another important explanation. Because international trade usually takes longer period of time and incur more risks than domestic trade, exporters tend to be more heavy users of trade finance

than domestic firms. The sudden financial arrest hurts international trade, especially the sectors intensively depends on trade finance, and then reduces the supply of exports.

Ahn et al. (2011), Amiti and Weinstein (2009), Chor and Manova (2010) and Feenstra, Li, and Yu (2011) provide both empirical and theoretical analyses in support of this explanation. In Haddad, Harrison, and Hausman (2010), they show that both demand-side and supply-side reasons play a part in the recent trade collapse. Other than these fundamental forces, Bems, Johnson, and Yi (2011) and Yi (2009) show that the global supply chains speed up the transmission of the trade collapse from the epicenter of the recession to other countries. Levchenko, Lewis, and Tesar (2010) also show empirical evidence for this mechanism.

Imported intermediate inputs are the conduits. Anderton and Tewolde (2011) also provides some evidence for this explanation. In addition, in explaining the high elasticity of international trade to GDP, Alessandria, Kaboski, and Midrigan (2010) emphasize that international trade meets the demand for both sales and inventory investments. Since inventories are procyclical, international trade is much more volatile than sales.

Though our paper also predicts and shows that economic crisis hits the intensive margin of exports due to demand-side collapse and external finance does matter for exporters, it differs from the existing literature that the extensive margin of exports may indeed benefit from the countercyclical measure of external finance: governments usually respond to economic crisis by reducing interest rate. As a result, we predict and show that the extensive margin of exports may even increase during economic crisis.

3. Trade Collapse Decomposition

3.1. Main results

In order to quantify the contraction of China's exports and investigate which margin contribute most to China's export collapse, we decompose the changes along the line

suggested by Bernard et al. (2009).

China's total exports X in a given year can be decomposed as X = f · c · p · x, where f, c, p, and x denote the number of firms, average number of destination countries per firm, the average number of products per firm-country combination, and the average export value per firm-product-country combination, respectively. Then export changes in terms of trade ratios could be decomposed as the changes in all the other variables:

$$\Delta X = \Delta f \cdot \Delta \overline{c} \cdot \Delta \overline{p} \cdot \Delta \overline{x}.$$

Comparing China's exports in 2009 and 2008, it drops by 15.44%. Table 1 presents the decomposition of this large fall.

Table 1: Decomposition of China's Total Exports

Year	Total	Extensive Margin			Intensive Margin
		No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	1899.86	206460	9.05	4.05	251.14
2009	1606.43	216173	8.68	4.17	205.28
		4.70%	-4.11%	3.03%	
(Δ-1)	-15.44%	3.45%			-18.26%

Notes: The data does not include the exports to the regions labeled as "all else areas." Total exports are measured at billion dollars. Average value is measured at thousand dollars.

In terms of the intensive margin, it involves three parts: the number of exporting firms, average number of countries that a firm export to, and the average number of products that a firm export to a country. Compared with the previous year, the number of firms increases by 4.7%. More firms become exporters. The average number of countries that a firm export to is negatively affected by the financial crisis. It decreases by 4.1%. The third component of the extensive margin, i.e. the average number of products that a firm export to a country, has also increased in 2009. It rises by 3.03%, which implies that exporting firms have expanded their product scope. Overall, the total change at the extensive margin for China's exports is (1.047 ∗ 0.9589 ∗ 1.0303−1) ∗ 100% =3.45%. The large fall in China's total exports is mainly

manifested on the intensive margin, i.e. the average value that a firm exports a product to a country. From 2008 to 2009, it drops from 251.14 to 205.28 thousand dollars. It decreases by 18.26%.

It is not hard to understand that extensive margins are less influenced than intensive margins during economic downturns. Exporting firms tend to maintain their existing networks since it usually takes ex-ante investment to develop the networks. This finding is consistent with the ones that Behrens et al. (2010) find for Belgium firms and Schott (2009) finds for US trade in the 2008–2009 crisis, and Bernard et al. (2009) observe for US trade in the 1997 Asian financial crisis. But in all these papers, they have found that both the extensive margins and intensive margins have decreased in the economic downturns. However, in our analysis, we have observed that the extensive margin of China's exports goes up, along with the decreasing intensive margin.

One concern about this finding is that this result could be driven by firm dynamics. Some firms could export in 2007, stop exporting in 2008, but resume exporting in 2009. In order to make sure our results are not driven by this issue, we have also done the decomposition on surviving exporting firms only. Surviving firms could be defined at different levels. To implement the decomposition, we define it at the firm level and the country level. Panel A in Table 2 presents the analysis at the firm level. Surviving exporters at this level refer to the firms who exports in both years, no matter which country the firms export to. Panel A shows that the average number of HS6 products at each firm-country combination still increases, although the total extensive margin drops due to the decrease in the average number of countries decreases which is similar to the pattern in Table 1. Panel B in Table 2 reports the decomposition at the country level. At this level, we focus on the exporting firms who exported to the same country in both years. We still find that the number of products for these surviving firms increases during the financial crisis.

Table 2: Exports decomposition for surviving exporters

A. Surviving exporters		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	1852.32	173687	9.99	4.07	262.25
2009	1534.64	173687	9.68	4.14	220.59
		0	-3.15%	1.69%	
(Δ-1)	-17.15%		-1.51%		-15.88%
B. Market survivors		Extensive Margin			Intensive Margin
		No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	1751.81	166441	6.67	4.93	319.90
2009	1461.25	166441	6.67	5.03	261.55
		0	0	2.02%	
(Δ-1)	16.59%		2.02%		-18.24%

Notes: The data does not include the exports to the regions labeled as "all else areas." Total exports are measured at billion dollars. Average value is measured at thousand dollars.

Another concern is related to the intermediaries. Generally speaking, they behave differently from ordinary exporters. In terms of markets, Ahn, Khandelwal, and Wei (2011) shows that intermediaries are relatively more important in markets that are more difficult to penetrate. In terms of products, Feenstra and Hanson (2004) have found that entre-pot exports through Hong Kong account for a larger share of Chinese exports for differentiated products than for homogeneous products. Tang and Zhang (2012) also argue that intermediary is more prevalent for more horizontally differentiated products but less for more vertically differentiated products.

Table 3: Exports decomposition for non-intermediary firms

Year	Total	Extensive Margin			Intensive Margin
		No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	1565.45	160865	7.78	2.95	423.41
2009	1336.25	166238	7.56	2.99	355.50
		3.34%	-2.92%	1.33%	
(Δ-1)	-14.64%		1.66%		-16.04%

Notes: The data does not include the exports to the regions labeled as "all else areas." Total exports are measured at billion dollars. Average value is measured at thousand dollars.

Since intermediaries usually take more than 20% of China's exports in value,[3] it is better to check the decomposition results without the exports done by intermediaries. Table 3 shows that our previous finding remains—the extensive margin still increases in 2009.

3.2. Decomposition at the Disaggregated Levels

In order to show our finding is robust, we present the results for different types of products or the exports to different regions. For most categories studied, the extensive margins of China's exports have increased, and their corresponding intensive margins simultaneously decrease during the 2009 financial recession.

Table 4: Decomposition of China's Exports by Rauch Classification

Differentiated		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	1744.58	193940	9.01	4.00	249.64
2009	1487.17	203372	8.62	4.13	205.44
		4.86%	-4.32%	3.24%	
(Δ-1)	-14.76%		3.58%		-17.70%
Reference		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	93.03	49737	4.11	1.55	293.14
2009	71.51	51567	4.14	1.57	210.10
		3.68%	0.66%	1.32%	
(Δ-1)	-24.21%		5.74%		-28.33%
Homogeneous		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	18.18	5419	2.29	1.22	1205.60
2009	12.70	5566	2.29	1.20	827.51
		2.71%	0.22%	-1.17%	
(Δ-1)	-30.17%		1.74%		-31.36%

Notes: The data does not include the exports to the regions labeled as "all else areas." Total exports are measured at billion dollars. Average value is measured at thousand dollars.

[3] Chen and Li (2014) have shown that the share taken by intermediaries has been decreasing from 38.5% in 2000 to 23% in 2006 in Table 1.

Tables 4 and 5 present the analysis for different categories of products. Table 6 demonstrate the results for the exports going to different regions.

Table 5: Decomposition of China's Exports by BEC Classification

Capital		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	587.42	65966	7.01	2.18	582.90
2009	532.17	69443	6.78	2.24	505.63
		5.27%	-3.40%	2.70%	
(Δ-1)	-9.41%		4.44%		-13.26%
Consumption		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	532.71	111897	8.32	3.50	163.34
2009	481.59	117349	7.87	3.57	146.13
		4.87%	-5.39%	1.85%	
(Δ-1)	-9.60%		1.05%		-10.53%
Intermediate		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	761.64	153870	7.49	2.86	231.52
2009	576.42	161016	7.25	2.97	166.01
		4.64%	-3.19%	4.18%	
(Δ-1)	-24.32%		5.54%		-28.29%

Notes: The data does not include the exports to the regions labeled as "all else areas." Total exports are measured at billion dollars. Average value is measured at thousand dollars.

Table 4 shows the results when we classify the HS6 products by the conservative classification proposed by Rauch (1999). Table 5 gives the results when we group the products by Broad Economic Categories (BEC) classifications. It is designed by UNSD. All BEC groups are meaningful in the framework of the System of National Accounts (SNA), and they are classified to three basic classes: consumption goods, intermediate goods, and capital goods. For both tables, we have observed the same patterns as in Table 1. Table 6 presents the results when we divide China's exports by the continents to which the exports go. Among all sub-groups, only the extensive margin for Europe decreases during this recession.

Table 6: Decomposition of China's Exports by Regions

Asia		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	823.51	168869	4.13	4.51	261.79
2009	710.82	175709	4.07	4.62	215.21
		4.05%	-1.51%	2.46%	
(Δ-1)	-13.69%		5.00%		-17.79%
Africa		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	56.65	54313	2.96	3.73	94.58
2009	53.08	57770	2.91	4.07	77.60
		6.36%	-1.65%	9.17%	
(Δ-1)	-6.31%		14.20%		-17.96%
Europe		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	475.88	116656	5.11	3.64	219.35
2009	370.83	120725	4.77	3.69	174.50
		3.49%	-6.75%	1.50%	
(Δ-1)	-22.08%		-2.05%		-20.45%
Latin America		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	85.36	64423	3.21	3.03	136.28
2009	70.12	67066	3.09	3.13	108.25
		4.10%	-3.91%	3.37%	
(Δ-1)	-17.86%		3.40%		-20.56%
North America		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	421.82	95110	1.40	5.50	576.60
2009	366.59	97138	1.39	5.62	485.07
		2.13%	-0.92%	2.09%	
(Δ-1)	-13.10%		3.30%		-15.87%
Oceania		Extensive Margin			Intensive Margin
Year	Total	No. (firms)	Average No. (countries/firm)	Average No. (HS6/firm-country)	Average value of firm-country-HS6
2008	34.66	51314	1.41	3.98	119.81
2009	33.14	53169	1.41	4.10	107.92
		3.61%	-0.47%	2.93%	
(Δ-1)	-4.39%		6.15%		-9.92%

Notes: The data does not include the exports to the regions labeled as "all else areas." Total exports are measured at billion dollars. Average value is measured at thousand dollars.

In summary, it is clear that the collapse of China's exports in the 2009 financial crisis is mainly driven by the drop on intensive margins. At both aggregated and disaggregated levels, during the recession, the extensive margins of China's exports go up along with the dropping intensive margins, which is different from the previous literature. This unique phenomenon calls for a sound explanation.

4. A model with external finance for export

In this section, we follow Melitz (2003) model and extend it by assuming that a firm need to rely on external finance to cover its fixed cost in each period of production.

4.1. Demand

We assume that a representative consumer has a two-tier utility function. The first (outer) tier is a Cobb-Douglas over all the composite goods Ci:

$$U = \prod_{i \in I} C_i^{\alpha_i}$$

where parameters are larger than zero and sum up to one.

The second (inner) tier is that a composite good Ci is CES over its varieties:

$$C_i = \left[\int_{\omega_{ij} \in \Omega_i} q(\omega_{ij})^{\rho_i} d\omega_{ij} \right]^{1/\rho_i}$$

where w_{ij} is a variety of goods belonging to the consumption basket. The letter q stands for consumption on that product w_{ij}. The elasticity of substitution between varieties in included as a compound parameter. Therefore, the exact price index for good Ci is,

$$P_i = \left[\int_{\omega_{ij} \in \Omega_i} p(\omega_{ij})^{1-\sigma_i} d\omega_{ij} \right]^{\frac{1}{1-\sigma_i}}$$

Due to the dual structure of aggregate utility and quantity, we can further express the demand quantity and revenue/expenditure as the following.

$$q(\omega_{ij}) = Q_i \left[\frac{p(\omega_{ij})}{P_i}\right]^{-\sigma_i}$$

$$r(\omega_{ij}) = R_i \left[\frac{p(\omega_{ij})}{P_i}\right]^{1-\sigma_i}$$

4.2. Production

As in Melitz (2003), firms differ simply from their productivity. Prior to entry, a potential firm pays an entry cost f_E and draw a productivity randomly from a given distribution. Different from Melitz (2003), the productivity here is industry-firm specific. We replace it with a new parameter hereafter. As in Manova (2008), we assume operating firms at the beginning of each production period/round have to rely on external finance to cover its (per period) fixed cost and variable cost with interest rate r. For simplicity, we assume that potential firms can cover the entry cost by their initial endowments. They will pay back the loans with interest after sales at the end of each period. For simplicity, we drop the subscripts in the following discussion but pick it up later. Assume a firm's (exchangeable, a production line's) labor demand function is,

$$\ell = f + \frac{q}{\varphi}$$

where f is the per-period fixed cost, and the parameter as denominator denotes its specific productivity. We opt out all the risks associated with asymmetric information and exchange rate volatility. By normalizing wage to be unity, an operating firm's marginal cost is (r + 1) when selling domestically. However, when exporting, firms need to pay a fixed cost per market, f^m, and an iceberg cost per unit.

It is immediate that the firm's pricing rule is

$$p(\varphi) = \begin{cases} \frac{1+r}{\rho\varphi} & \text{if it is for domestic sales} \\ \frac{\tau(1+r)}{\rho\varphi} & \text{if it is for foreign sales} \end{cases}$$

A firm operates monopolistically on its product c_{ij}. Given demand elasticity, its domestic sales, r_d and exporting sales r_x in market/country m, are respectively given by

$$r_d(\varphi_{ij}) = R_i \left(\frac{P_i \rho_i \varphi_{ij}}{1+r} \right)^{\sigma_i - 1}$$

$$r_x^m(\varphi_{ij}) = R_i^m \left(\frac{P_i^* \rho_i \varphi_{ij}}{\tau(1+r)} \right)^{\sigma_i - 1}$$

And their profits are represented by the following two equations.

$$\pi_d(\varphi_{ij}) = \frac{r_d(\varphi_{ij})}{\sigma_{ij}} - (1+r)f = \frac{R_i}{\sigma_i} \left(\frac{P_i \rho_i \varphi_{ij}}{1+r} \right)^{\sigma_i - 1} - (1+r)f$$

$$\pi_x^m(\varphi_{ij}) = \frac{r_x^m(\varphi_{ij})}{\sigma_{ij}} - (1+r)f_x^m = \frac{R_i^m}{\sigma_i} \left(\frac{P_i^* \rho_i \varphi_{ij}}{\tau(1+r)} \right)^{\sigma_i - 1} - (1+r)f_x^m$$

4.3. Market equilibrium

Given the outer tier utility, it is immediate that domestic demand on a composite good C_i is a fraction of total income and the counterpart in a foreign market, m, is proportional to country m's total income, where total income is measured by GNI in both Home country and Foreign country m.

The goods market equilibrium indicates that

$$R_i = \alpha_i Y \text{ and } R_i^m = \alpha_i Y^m.$$

The cutoff productivity (ZCP) satisfies the following two conditions in both the domestic and foreign market.

$$\pi_d(\varphi_{ij}^*) = \frac{\alpha_i Y}{\sigma_i}\left(\frac{P_i \rho_i \varphi_{ij}^*}{1+r}\right)^{\sigma_i - 1} - (1+r)f = 0$$

$$\pi_x^m(\varphi_{ij}^m) = \frac{\alpha_i Y^m}{\sigma_i}\left(\frac{P_i^* \rho_i \varphi_{ij}}{\tau(1+r)}\right)^{\sigma_i - 1} - (1+r)f_x^m = 0$$

Free Entry (FE) condition indicates that the expected lifetime return should be equal to the entry cost. That is,

$$V = \frac{\pi_d}{r} = f_E$$

Under the assumption that fixed cost to total income ratio is larger in foreign markets, we can rule out the corner solution where some firms only export.[4] Furthermore, we assume the expenditure share is equal across goods to ensure that the marginal firm in operation has the lowest productivity which does not depend on the type of goods it produces.

The ZCP and FE conditions together with the two assumptions mentioned above guarantee a unique equilibrium exists.

$$\varphi_x^m = \left[\frac{(1+r)f_x^m \sigma_i}{\alpha Y^m}\right]^{\frac{1}{\sigma_i - 1}} \frac{\tau(1+r)}{P_i^* \rho_i}$$

In reality, countries spend most of their incomes on domestic goods which implies that foreign price index is exogenous to import prices and thus the change of productivity cutoff.

Facing global crisis with demand Y dipping, exporting country typically responds by lowering the financial constraint to firms, i.e. r decreases. Then we have the following proposition.

[Proposition] During external economic crisis with real GNI dipping, home country tends to ease money supply to reduce the financial costs to firms, i.e. r decreases. The impact of the

4 Dan Lu (2011) find that there some Chinese firms that are engaging pure exports. But such firms may be those which are engaging in processing trade which is not our focus in this paper.

joint shock depends on the relative speed of interest rate decrease versus foreign GNI dip. If the following condition holds, then the intensive margin decreases but the extensive margin increases.

$$\frac{1}{\sigma_i}\frac{1+r}{r} < \varepsilon < \frac{1}{\sigma_i - 1}\frac{1+r}{r}$$

[Corollary 1] Given the change in domestic interest rate, Home is more likely to see its extensive margin increase to those countries with smaller decrease in GNI.

[Corollary 2] Given the change in foreign GNI and domestic interest rate, goods with smaller elasticities of substitution (i.e. lower demand elasticities) would be more likely to have an increase in extensive margin and decrease in intensive margin and the magnitude of the impact is larger in both margins.[5]

5. Empirical results

In this section, we first test the hypotheses about extensive margins, followed by the analysis on intensive margins. In each part, we begin with the analysis on two key variables — the growth rates of export destination countries' demand shock and real loan interest rates of different sectors faced by Chinese exporters. Then we study Corollary 2 to investigate whether the impacts are different in magnitude as the elasticity of substitution varies across products. The estimation results for differentiated and homogeneous goods are compared. Meanwhile we also study the hypothesis that the negative effect associated with the growth rates of real interest rates is reduced when industries highly depend on external finance.

Our export data starts from 2007 and ends in 2011. It is at the firm-year-HS8-country level. The summary statistics is shown in Table 7 below. Over the five years, it involves 359836

[5] Chaney (2008) also discusses the different effects of elasticities of substitutions on intensive and extensive margins, respectively.

exporting firms, 238 destination countries, 7904 HS 8-digit Chinese classifications of products. For small destination countries, we often observe that no firm exports in many HS 8-digit product markets. In order to deal with this problem, we only keep the top 103 countries which account for 99% of China's exports in value in 2007, i.e. the earliest year in our sample period.

Table 7: Basic Statistics for Export Data

Year	Value	No.(firms)	No.(CN8)	No.(Markets)
2007	1220.06	193567	7172	235
2008	1430.57	206452	7211	232
2009	1201.61	216221	7322	234
2010	1577.75	234368	7364	234
2011	1898.49	254618	7405	235

Notes: calculated by the authors. Values are in billion US dollars.

Our variables of interest are the growth rates of importing countries demand shocks and the growth rate of real loan interest rates faced Chinese exporters. The demand shock for different importing countries comes from UN Comtrade. It is measured by the total imports of a destination country excluding the one from China.

Real interest rate, is constructed by subtracting inflation rates from the annual nominal loan interest rates. The nominal loan interest rates come from China Banking Regulatory Commission. This nominal annual loan interest rate varies at the 2-digit level of China National Industry Classification. The nominal loan interest rate of less than or equal to one year is utilized in the main analysis to precisely capture how loan interests maneuver the decision of exporting firms. The data on inflation rates comes from China's National Bureau of Statistics.

In order to test our corollaries, another two variables—external financial dependence and product classification are needed. Our classification of products is based on the Rauch (1999). The external dependence (ED) is constructed following Rajan and Zingales (1999). In order to

relieve the endogeneity concern that a firm's capital usage is sensitively affected by the financial costs, we use the data from listed US companies to construct ED for different industries. The data used in constructing external dependence come from Compustat data set. The construction method on external dependence is shown in Appendix.

5.1. Results on extensive margins

The specification for the study on extensive margins is demonstrated in the following equation.

$$\begin{aligned}\dot{EX}_{cpt} =& \alpha_1 \dot{GDP}_{ct} + \alpha_2 \dot{GDP}_{ct} D_p^{dif} \\ &+ \beta_1 \dot{i}_t^r + \beta_2 \dot{i}_t^r D_p^{dif} + \beta_3 \dot{i}_t^r ED_p + \beta_4 \dot{i}_t^r ED_p D_p^{dif} \\ &+ ln(N_{cp,t-1}^f) + FEs + \varepsilon_{cpt}\end{aligned}$$

The unit of observations is at the CN8/country/year level. Our dependent variable here is the growth rates of extensive margins, captured by the number of exporters (N_{fcpt}) at the CN8–country combination in a particular year.

Unsurprisingly, some country–product combinations have no firm in sometimes. We may introduce some measurement errors. In order to deal with this problem, we also measure the growth rate of extensive margins similar as growth rate. Unsurprisingly, the growth rates of extensive margins are missing whenever the number of firms just turns to be positive. This measure reduces the number of observations more than half. The results for this measure will be shown as one robustness test. Our key variables are the growth rates of total imports of a country excluding the one from China and the one of real interests.

In order to test Corollary 2, we interaction our two key variables with differentiated good dummy. We expect the interaction between imports and differentiated good dummy to be positive, and the interaction term between differentiated goods and interest rates to be negative. These predictions imply that the positive effect from importing countries' demand

shock and the negative effect associated with interest rates are both intensified when it comes to differentiated goods, the goods with smaller elasticities in magnitude than homogeneous and reference goods.

We also interact our two key variables with external dependence at the sector level. We expect that its coefficient is negative and statistically significant, which implies that the negative effect associated with the drop of interest rates is diluted in the industry highly depending.

Table 8: Basic Results, cn8, Extensive Margins

	(1) All	(2) All	(3) All	(4) All	(5) Dif	(6) Ref+Homo
IM_{ct}	0.0726^a	0.0745^a	0.0330^a	0.0244^a	0.0903^a	0.0163^a
	(0.00353)	(0.00400)	(0.00649)	(0.00769)	(0.00464)	(0.00469)
$\dot{IM}_{ct}\cdot D_p^{dif}$			0.0517^a	0.0636^a		
			(0.00847)	(0.0101)		
$\dot{i}_t^r$	-0.0219^a	-0.0468^a	-0.0156^a	-0.0361^a	-0.0617^a	-0.0154^c
	(0.00487)	(0.00827)	(0.00329)	(0.00962)	(0.0164)	(0.00858)
$\dot{i}_t^r\cdot ED_p$		0.0000712^a		0.0000872^a	0.0000382	0.0000809^a
		(0.0000224)		(0.0000322)	(0.0000244)	(0.0000311)
$\dot{i}_t^r\cdot D_p^{dif}$			-0.00413^a	-0.00219		
			(0.00127)	(0.00165)		
$\dot{i}_t^r\cdot ED_p\cdot D_p^{dif}$				-0.0000489		
				(0.0000408)		
$\ln(1+N_{cp,t-1}^f)$	-0.0971^a	-0.0978^a	-0.0978^a	-0.0992^a	-0.0947^a	-0.157^a
	(0.00430)	(0.00455)	(0.00440)	(0.00468)	(0.00485)	(0.0138)
Constant	4.735^a	4.739^a	4.737^a	4.744^a	4.752^a	4.687^a
	(0.00684)	(0.00783)	(0.00683)	(0.00819)	(0.0108)	(0.0110)
N	2715840	2262855	2637525	2193855	1742595	451260
R^2	0.046	0.046	0.047	0.047	0.046	0.075
RMSE	0.450	0.462	0.451	0.464	0.485	0.370

Note: HS 4-digit FEs, year FEs, country FEs are all controlled for. Standard errors in parentheses are clustered at the HS 4 digit level with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels.

In the estimation specification, we also control for the number of exporting firms in the previous year since our dependent variable is the growth rate of the number of exporters. It is

hard to imagine sectors keep growing very fast when they are already saturated. Our specification also controls for HS 4-digit, country, and year fixed effects.

Table 8 presents the basic estimation results. In column 1, the coefficient for GDP_{ct} is positive and statistically significant at one percent level, which implies that export destination countries' GDP's growth rates have a positive effect on the growth of China's export extensive margins. Column 1 also shows that the growth rate of real loan interest rates has a significantly negative effect on the change of extensive margins. And the coefficient for interest rate is much larger than the one for GDP growth in terms of absolute magnitudes. As expected, the lagged firm number is negative and statistically significant.

In column 2, we put another term which is the interaction term between external dependence and the change of real interest rates. We expect that the real interest rate's effect becomes stronger in absolute magnitude when an industry's external dependence measure is high. Column 2 of Table 8 shows that the coefficient of the interaction between interest rate and external financial dependence is negative and statistically significant at one percent level, which provides another good evidence for the negative impact of real loan interest rates on the growth of extensive margins.

In order to test Corollary 2, in contrast to column 1, we put another two interaction terms, one for each key variable. Corollary 2 predicts that the two key variables' impacts will be stronger in magnitude when a product's elasticity of substitution is smaller. Compared with homogeneous and reference goods, differentiated goods have smaller elasticity of substitutions. Therefore, according to Corollary 2, we expect that the impacts of the two key variables will be intensified for differentiated products in particular. Column 3 gives the results. It is found that in line with Corollary 2, the effect of GDP and real interest rates' growth rates are both magnified in magnitude for differentiated goods, and the coefficients of both interaction terms are statistically significant at one percent level.

Table 9: Surviving country-product (iso-cn8) dyads only, Extensive Margins

	(1) All	(2) All	(3) All	(4) All	(5) Dif	(6) Ref+Homo
$\dot{IM}_{ct}$	0.186^a	0.182^a	0.139^a	0.112^a	0.197^a	0.0608^a
	(0.00750)	(0.00793)	(0.0223)	(0.0231)	(0.00833)	(0.0192)
$\dot{IM}_{ct}\cdot D_p^{dif}$			0.0541^b	0.0794^a		
			(0.0239)	(0.0252)		
$\dot{i}_t^r$	-0.0363	-0.143^a	-0.0520^a	-0.132^a	-0.142^a	-0.119^b
	(0.0234)	(0.0292)	(0.0156)	(0.0307)	(0.0371)	(0.0518)
$\dot{i}_t^r\cdot ED_p$		0.000155^a		0.000367^a	0.000110^a	0.000367^a
		(0.0000411)		(0.0000898)	(0.0000394)	(0.0000871)
$\dot{i}_t^r\cdot D_p^{dif}$			-0.0134^a	-0.00424		
			(0.00334)	(0.00401)		
$\dot{i}_t^r\cdot ED_p\cdot D_p^{dif}$				-0.000256^a		
				(0.0000989)		
$\ln(1+N_{cp,t-1}^f)$	-0.103^a	-0.104^a	-0.103^a	-0.105^a	-0.0989^a	-0.193^a
	(0.00357)	(0.00362)	(0.00366)	(0.00371)	(0.00366)	(0.0101)
Constant	4.862^a	4.828^a	4.850^a	4.830^a	4.827^a	4.867^a
	(0.0137)	(0.0156)	(0.0119)	(0.0160)	(0.0186)	(0.0306)
N	1008659	900465	982892	876335	777618	98717
R^2	0.049	0.050	0.049	0.050	0.050	0.075
RMSE	0.544	0.542	0.544	0.541	0.540	0.546

Note: HS 4-digit FEs, year FEs, country FEs are all controlled for. Standard errors in parentheses are clustered at the HS 4 digit level with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels.

In column 4, we put all interaction terms in one regression. Because key variables and interaction terms are highly correlated, we only observe the coefficients of variables are statistically significant at one percent level. In order to alleviate the multi-collinearity problem, we classify the sample to two categories—differentiated and non-differentiated goods. Then we run the specification in column 2 for each sub-sample, respectively. In line with our expectation, the results found in column 2 are drive by differentiated goods. The coefficient for GDP growth rates for differentiated goods is twice of the one for non-differentiated goods. The coefficients on real interest rates and its interaction term are both statistically

insignificant. The contrast of the results between the last two columns clearly supports Corollary 2.

Table 10: HS6 digit, full data, extensive margins

	(1) All	(2) All	(3) All	(4) All	(5) Dif	(6) Ref+Homo
$I\dot{M}_{ct}$	0.0898^a	0.0912^a	0.0354^a	0.0250^a	0.114^a	0.0179^a
	(0.00435)	(0.00484)	(0.00784)	(0.00907)	(0.00552)	(0.00629)
$I\dot{M}_{ct}\cdot D_p^{dif}$			0.0734^a	0.0868^a		
			(0.00990)	(0.0115)		
$\dot{i}_t^r$	-0.0312^a	-0.0540^a	-0.0177^a	-0.0389^a	-0.0709^b	-0.0209^b
	(0.00497)	(0.0108)	(0.00438)	(0.0124)	(0.0292)	(0.0103)
$\dot{i}_t^r\cdot ED_p$		0.000105^a		0.000132^a	0.0000649^b	0.000126^a
		(0.0000264)		(0.0000415)	(0.0000280)	(0.0000402)
$\dot{i}_t^r\cdot D_p^{dif}$			-0.00428^a	-0.00167		
			(0.00151)	(0.00186)		
$\dot{i}_t^r\cdot ED_p\cdot D_p^{dif}$				-0.0000663		
				(0.0000504)		
$\ln(1+N_{cp,t-1}^f)$	-0.0790^a	-0.0797^a	-0.0796^a	-0.0806^a	-0.0767^a	-0.127^a
	(0.00289)	(0.00305)	(0.00296)	(0.00313)	(0.00329)	(0.00661)
Constant	4.735^a	4.739^a	4.739^a	4.745^a	4.754^a	4.689^a
	(0.00584)	(0.00758)	(0.00584)	(0.00803)	(0.0141)	(0.00900)
N	1687740	1412775	1632195	1362750	1049145	313605
R^2	0.041	0.042	0.042	0.043	0.043	0.062
RMSE	0.419	0.427	0.419	0.428	0.447	0.354

Note: HS 4-digit FEs, year FEs, country FEs are all controlled for. Standard errors in parentheses are clustered at the HS 4 digit level with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels.

In order to test whether our results are robust or not, we run the same specifications as in Table 8 with the alternative measurement. This measure changes the measure of dependent variable. More importantly, it reduces missing observations because number 1 is added for all observations in the balanced panel before taking logs. The sample size increases a lot relative to Table 8. All our major results remain qualitatively. All coefficients which are statistically significant in Table 8 remain significant, although the magnitudes of them become smaller.

5.2. Results on intensive margins

In this section, we will discuss the analysis on intensive margins. Following the same structure in the discussion on extensive margins' growth rates, we will first introduce the estimation methods and then show the main results. In the last part of this section, we will discuss the results for robustness tests.

The model specification for intensive margins follows the estimation specification below. The analysis is implemented at the firm-product-country-year level.

$$\begin{aligned} \dot{IN}_{fcpt} =& \alpha_1 \dot{GDP}_{ct} + \alpha_2 \dot{GDP}_{ct} D_p^{dif} \\ &+ \beta_1 \dot{i}_t^r + \beta_2 \dot{i}_t^r ED_p + \beta_3 \dot{i}_t^r D_p^{dif} + \beta_4 \dot{i}_t^r ED_p D_p^{dif} \\ &+ ln(X_{fcp,t-1}) + FEs + \varepsilon_{cpt} \end{aligned}$$

The product refers to HS 6-digit level. It is natural to expect that one firm does not export in all product/country markets. The data used to study intensive margins is not balanced as a whole. But it is balanced on each firm-product-country combination, which implies that as long as a firm i has exported product p to country c in one year, this firm-product-country combination is also available for all the other years in the sample.

This data structure allows us to measure intensive margin's growth rate as in logarithm form. The major results for intensive margins are obtained with this measure. Similar to the measure of extensive margin in the previous subsection, we also measure the intensive measure by adding one inside the logarithm term which reduces the number of missing observations and increases the sample size. The estimation results with this measure will be shown as robustness tests. In the specification on extensive margins, all variables of interest are the same as the ones in the study of extensive margins. But different from the specification for intensive margins, other than this HS 4-digit, country, and year fixed effects, we also control for exporting firms' fixed effects. Similar to the specification for the analysis on extensive margins, the export value of the firm f in country c on product p in the previous year

is controlled for to the growth rates of firms' export intensive margins.

Table 14: Basic Results on Intensive Margins

	(1) All	(2) All	(3) All	(4) All	(5) Dif	(6) Ref+Homo
$\dot{IM}_{ct}$	0.643^a	0.623^a	0.596^a	0.475^a	0.642^a	0.344^a
	(0.0369)	(0.0408)	(0.0715)	(0.0579)	(0.0428)	(0.0840)
$\dot{IM}_{ct}$*D_p^{dif}			0.0561	0.162^a		
			(0.0715)	(0.0602)		
$\dot{i}_t^r$	-0.199^b	-0.220^b	-0.283^a	-0.242^a	-0.190^c	-0.327^b
	(0.0792)	(0.0865)	(0.0548)	(0.0914)	(0.104)	(0.144)
$\dot{i}_t^r$*ED_p		0.000216^c		0.00137^a	0.000127	0.00139^a
		(0.000131)		(0.000320)	(0.000140)	(0.000323)
$\dot{i}_t^r$*D_p^{dif}			-0.0116	0.0157		
			(0.00972)	(0.00979)		
$\dot{i}_t^r$*ED_p*D_p^{dif}				-0.00124^a		
				(0.000349)		
N	104977246	91176118	101682601	88064736	84367999	3695760
R^2	0.040	0.040	0.040	0.040	0.040	0.048
RMSE	5.210	5.196	5.214	5.200	5.195	5.356

Note: Fixed effects at the firm level, HS 4-digit product level, country level, and year levels are all controlled for. Standard errors in parentheses are clustered at the HS 4 digit level with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. $\ln(1+EX_{fcp,t-1})$ is controlled for. Its coefficients are all negative and statistically significant.

Table 14 presents the basic results on intensive margin. Consistent with our hypothesis, column 1 shows that GDP growth has a positive and significant effect on the growth rate of intensive margins, and the growth rate of real loan interest rate has a significantly negative effect. Similar to the results on extensive margins, the coefficient for real interest rates is much larger in absolute magnitude than the one for importing country's GDP's growth rates.

In column 2, we test whether an industry with high external financial dependence is more intensively affected by the change of interest rates. The result shows that the positive and significant coefficient of interest rate changes shown in the first column is mainly driven by the high external finance dependence industries. Once we include the interaction term of

interest rate growth and external financial dependence, the positive coefficient of interest rate becomes statistically insignificant, which implies that, just in terms of exports' intensive margins, the decrease of real loan interest rates during the 2009 financial crisis mainly affected the high financial dependence industries rather than all industries. Compared with the corresponding results on extensive margins in Table 8 where both interest rate changes and its interaction with external finance are significant, the difference has provided some evidence for our key prediction of this paper, i.e. intensive margins are less sensitive than extensive margins to the change of interest rates.

In column 3, we test Corollary 2. Corollary 2 suggests that both GDP's and real interest rates should have stronger effects on differentiated goods than homogeneous and reference goods, because differentiated goods have lower elasticities of substitution. Corollary 2 is not well supported in column 3 in this table. The coefficients of GDP growth and interest rate changes remain significant and positive in line with the hypothesis. However, the influences of the growth rates of real interest rates and importing countries' GDP do not seem to intensify on differentiated goods in particular.

In column 4, we put all interaction terms in the specification. We find that GDP growth still has a significant and positive effect on the growth rate of firms' intensive margins. The coefficient of interaction between exchange rate growth and GDP, similar to column 3, remains positive, but it becomes significant.

To alleviate the concern of multi-collinearity, we separate the sample to differentiated and non-differentiated goods, and re-run the specification in column 2 for each group, respectively. Comparing the coefficients of the interaction between interest rate and external finance dependence in columns 4 and 5 in Table 14, we can easily realize that they represent what have been shown in columns 2 and 3. GDP increases the growth rates of a firm's exports for differentiated and non-differentiated goods equally. Interest rate changes seem to promote the

homogeneous goods' exports only.

Since homogeneous goods are mainly bulk goods, it seems to indicate that the decrease of interest rates during the financial crisis increases the exports of low-end products, even though we do observe that firms in the industries with high external financial dependence expand their exports of differentiated goods in value. It is clear that the strong and significantly negative effect of interest rate changes in column 1 is driven by the high financial dependence industries within differentiated goods and all homogeneous industries.

Table 15: Surviving exports only, intensive margin

	(1) All	(2) All	(3) All	(4) All	(5) Dif	(6) Ref+Homo
$\dot{IM}_{ct}$	0.261^{a}	0.271^{a}	0.142^{a}	0.166^{a}	0.274^{a}	0.201^{a}
	(0.0129)	(0.0135)	(0.0324)	(0.0392)	(0.0139)	(0.0690)
$\dot{IM}_{ct}$*D_p^{dif}			0.126^{a}	0.110^{a}		
			(0.0328)	(0.0391)		
$\dot{i}_t^r$	-0.0395	0.0461	-0.113^{a}	0.0308	0.125^{a}	-0.147^{b}
	(0.0306)	(0.0500)	(0.0338)	(0.0539)	(0.0282)	(0.0732)
$\dot{i}_t^r$*ED_p		0.0000399		0.000191	0.0000578	0.000189
		(0.0000520)		(0.000252)	(0.0000618)	(0.000272)
$\dot{i}_t^r$*D_p^{dif}			0.0176^{a}	0.0210^{b}		
			(0.00474)	(0.00844)		
$\dot{i}_t^r$*ED_p*D_p^{dif}				-0.000136		
				(0.000258)		
N	10582243	9206715	10301329	8943166	8490632	439678
R^2	0.049	0.051	0.050	0.051	0.051	0.107
RMSE	1.569	1.569	1.567	1.566	1.568	1.523

Note: Fixed effects at the firm level, HS 4-digit product level, country level, and year levels are all controlled for. Standard errors in parentheses are clustered at the HS 4 digit level with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. $\ln(1+EX_{fcp,t-1})$ is controlled for. Its coefficients are all negative and statistically significant.

Table 15 presents the estimation results when the export intensive margin is measured using the alternative measure. All missing observations are replaced with zeros, and the sample size increases a lot. More importantly, a firm's export growth rates for the first year when it just starts exporting a product p to a country c is captured with a positive number, not

missing any more. After this change, we find that GDP's growth rates and its interaction term with D^{dif} have both significant and positive coefficients on the growth rate of intensive margins, which supports our hypotheses very well, different from the ones shown in Table 14.

When it comes to real interest rates, we still observe that interest rate changes have a significantly negative effect on the growth rate of exports' intensive margins mainly through high external financial dependence industries within differentiated goods and homogeneous products.

6. Conclusion

The recent global economic crisis severely hits international trade. However, this downturn may affect intensive and extensive margins of exports differently. In this paper, we extend Melitz (2003) model by allowing exporting firms to depend on external finance to cover their fixed costs. The model shows that though the exporting revenue of each firm (i.e. the intensive margin) unambiguously drops due to weaker foreign demand, the number of exporting firms (i.e. the extensive margin) may increase due to countermeasures taken by exporting countries, such as reducing in interest rate.

Evidences from China's exports during the 2009 financial crisis support the predictions. In terms of the sustainability of China's exports, we find that China's exports contract mainly on intensive margins during the 2008-2009 recession while the extensive margin indeed kept on expending. Detailed investigation in various geographic markets also confirms our theoretical results.

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Crisis, Financial Costs, and Export Margins: Evidence from China

平成 30 年 3 月発行

発行所　公益財団法人アジア成長研究所
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