Export Spillover and Export Performance in China

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Abstract: This paper examines the local export spillover effect on firm-level decisions to start exporting (the extensive margin) and export volume (the intensive margin) by exploiting a unique dataset of Chinese export firms. Based on a gravity-type equation estimated at firm level, we find that both nearby products and destination specific exporters positively influence the individual decisions of firms to start exporting and their export volumes. Several methods are used to verify the robustness of these results. The results imply that the local export spillover lowers both the fixed and variable cost of exporting. In addition, we find that the effect of export spillover on exporting that is both product and destination specific is stronger than it is on exporting that is either product or destination specific alone, but not both. Small and multi-product firms are more likely to be influenced by the spillover effect in their decisions to start exporting, and less likely to be influenced in their export volumes. Geographically, local export spillover effect is strongest on firms located in the same city; its effect on firms located in the same province but in different cities ranks second in terms of strength. This result indicates that the effect of local export spillover exhibits spatial decay in China.

Key words: Export spillover; Extensive margin; Intensive margin

JEL code: F10; R12

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1. Introduction

The characteristics of trading partners and the nature of traded products are both instructive for a country to learn from exporting (De Loecker, 2007; Goldberg et al., 2009; Verhoogen, 2008; Gill and Kharas, 2007; Haddad, 2007; Linden, Kraemer, and Dedrick, 2009). Therefore, investigating which factors determine the choices firms make in terms of trade partners and products for export has important policy implications for developing countries like China, which pursue sustainable growth based on innovation and enhanced productivity. Exporting is often associated with non-reversible entry costs required to penetrate foreign markets, such as research on foreign demand, establishment of networks, and development of new products adapted to the taste of foreign consumers (Clerides, Lach, and Tybout, 1998). Since these entry costs are knowledge intensive, information spillovers from existing exporters may have a positive impact on the export performance of other firms. Because the information spillover is highly localized and product and/or destination specific, it is more likely the case that firm-level exporting profits are higher for those products and destinations which more local firms handle. In other words, the agglomeration of exporters will prompt their neighbors to export the same products to the same countries.

This paper investigates the existence of export spillover effect among Chinese exporters.

Specifically, we examine the impact of geographic agglomeration of exporters on the export performance of nearby firms, including their export decisions (the extensive margin) and export volume (the intensive margin). In the literature, exporters benefiting from their local counterparts are called export spillover. Several insights have been offered to explain how the agglomeration of exporters influences the exporting performance of nearby firms. On the one hand, regarding the decision to start exporting, Krautheim (2008) argues that information sharing among firms exporting to the same destination reduces the firm-level export fixed cost and hence increases the local export propensity. On the other hand, pertaining to the intensive margin of exports, Rauch and Watson (2003) emphasize that the agglomeration of exporters effectively reduces the uncertainty of foreign buyers in terms of the quality of suppliers from the same region, and hence increases their demand of foreign exporters' products. Alternatively, Cassey and Schmeiser (2013) stress that exporters local to an agglomeration may benefit from sharing containers to save transportation costs. Both channels increase the firm-level intensive margin of exports.

Using a uniquely detailed dataset comprising Chinese export data at the product, firm, and destination country levels from 2000-2006, we find that the agglomeration of product and destination specific-exporters has a positive impact on the export decision (the extensive margin). While this positive effect still exists when the agglomeration of exporters is only product specific or destination specific but not both, it is much weaker than that when the agglomeration includes exporters who are both destination and product specific. Furthermore, the effect of agglomeration within the same region is stronger than that in other regions, exhibiting spatial decay. The spillover effect of the agglomeration of exporters which are both product and destination specific on export volume (the intensive margin) is also found positive and statistically significant. Similarly, this effect is stronger than that of agglomerations which are either destination specific or product specific but not both, and it diminishes with distance. Our findings indicate that the agglomeration of exporters could be an effective way to promote firms to export certain products to certain countries.

A number of studies have explored the existence of export spillovers, but there is no unified set of conclusions in the literature. While some research confirms the existence of export spillovers, others provide little evidence for them. For instance, Aitken, Hanson, and Harrison (1997) report a positive relationship between the export propensity of Mexican plants and the presence of multinational firms in the same state. Clerides, Lach, and Tybout (1998) study the behavior of export firms in three semi-industrial countries—Colombia, Mexico and Morocco—and find that the agglomeration of nearby exporters enhances the export propensity of domestically oriented producers by reducing the costs of breaking into foreign markets. Kneller and Pisu (2007) show that the presence of foreign multinational firms in the same industry or region positively influences the firm level intensive and extensive margins of export in the UK. Greenaway and Kneller (2008) confirm that decisions of firms in the UK to enter into the international market are positively influenced by regional and sectoral agglomeration. Koenig, et

al. (2010) provide evidence that the local agglomeration of product and destination specific-exporters positively impacts the export decision. However, they also find that the effect on the export volume of this kind of agglomeration is not significant. Analyzing a panel of Spanish firms, Barrios, Gorg, and Strobl (2003) find that neither export volume nor export decision is influenced by the presence of nearby exporters or multinational firms. Furthermore, Bernard and Jensen (2004) find that export spillovers play no role in export decisions made by U.S. manufacturing firms. Our paper can enrich the literature concerning whether export spillovers exist by adding Chinese evidence for consideration.

There are several papers that investigate export spillovers in China. Some research examines the role existing foreign affiliated firms plays in the creation of new trade linkages among domestic Chinese firms (Mayneris and Poncet, 2015; Swenson, 2008). Some researchers study how export decision is related to industrial agglomeration (e.g. Ito, Xu and Yashiro, 2015). Notably, all these studies have only looked at a small set of questions because detailed data on both the location of exporters and the destination of their exports has been lacking. Therefore, several important questions remain. What is the scope of export spillovers? Do export spillovers reduce variable cost, fixed costs, or both? Our paper can fill the gap in the literature by answering these questions.

The remainder of the paper is organized as follows: Section 2 discusses the empirical specifications to be estimated and related estimation issues. Section 3 introduces the data used. Detailed descriptive statistics on exports is also included in this section. Section 4 presents the empirical results and several robustness checks. We offer some conclusions in Section 5.

2. Empirical model and main variables

2.1 Empirical model

Following the literature on the structure and determinants of international trade flows, our empirical methodology to identify the impact of local export agglomeration on firm-level export propensity and volume is based on a gravity equation. A profit maximizing firm *i* starts to export product *k* to a country *j* in period *t* only if the realized profit abroad is positive. This means that the net profit for a firm *i* exporting a product *k* to a country *j* should meet the following requirement: $F_{ijkt} = \pi_{ijkt} + \varepsilon_{ijkt} > 0$. Where π_{ijkt} is the sum of observed part of the profits, and ε_{ijkt} is the unobserved part which contains characteristics of the firm, the region where the firm located, and the foreign markets the firm exports to. Net profit F_{ijkt} is associated with supply capability of the firm and trade friction. The higher the supply capability of the firm, the more the net profit is, and the more significant the trade friction, the less the net profit is. As discussed in the introduction, we pay special attention to the identification of the effects of export spillovers, which are assumed to affect net profit through lowering either the fixed or the variable cost of exporting. The probability that firm *i* stars to export a product *k* to country *j* at time *t* is given by,

$$P\left(y_{ikjt}=1\middle|x_{ikjt},\varepsilon_{ikjt}\right)=\Phi\left(\alpha x_{ikjt}+\gamma_{ijk}+\nu_t+\eta_{ikjt}\right) \quad (1)$$

Where y_{ijkt} is a dummy variable denoting the change of export status of a firm at the firm-product-country level. We will explain specifically how this variable is constructed in the following subsection. The composite error term ε_{ikjt} consists of a transitory component η_{ikjt}, time varied component ν_t and a time constant component γ_{ijk}.

x_{ijkt} is the vector including variables which could influence the export performance of firms. In addition to export spillovers, we also control the following variables: import volume, firm productivity, firm size, economic size of region studied, and distance between China and the destination country, each explained below. (1) Import volume is the import volume of product *k* from country *j* for firm *i* in year *t-1*. Importing product *k* from destination country *j* in the previous year provides firm *i* the market specific knowledge which may influence its export decision to this market. (2) Firm productivity. On the one hand, higher productivity is related to higher supply capability, and as such firms with higher productivity are more likely to export. On the other hand, more productive firms tend to self-select into denser areas (Melitz and Ottaviano, 2008). Therefore, controlling for firm productivity prevents an upward bias of the estimated coefficient of the spillover variables. (3) Firm size. Bernard and Jensen (1999) find that exporting firms are ex ante bigger than the others. This means that the size of the firm could positively affect export propensity. (4) Economic size of the area where firm *i* operates. Agglomerated areas are also areas abundant with laborers with different skill levels. This makes it much easier for local producers to employ laborers best-matched to their production, which could in turn have a positive effect on a firm's export performance. If the export spillovers variable is positively correlated with the size of area, omitting this variable will result in an overestimation of export spillovers. (5) Distance between China and destination country *j*. In the literature, distance is always deemed trade friction, which might have negative impact on the export performance.

Φ is the logistic cumulative distribution function indicating that we estimate using a logit model. Following Koenig, Mayeris, and Poncet (2010), in our estimation we control for year fixed effect and firm-product-country fixed effect. Year fixed effect captures effects common to all firms, products, and countries in the same year. Firm-product-country fixed effect captures all time-invariant product characteristics. Controlling for firm-product-country fixed effect is important because time constant unobserved variables likely affect the probability of exporting. It should be noted that the distance between China and the destination country will be omitted when the firm-product-country fixed effect is controlling for.

To investigate the effect of export spillovers on export volume, we estimate the following gravity-type equation at the firm level,

$$\exp_{ikjt}=\beta_0 x_{ijkt}+\gamma_{ijk}+\nu_t+\omega_{ikjt} \quad (2)$$

Where $\exp_{ijkt}$ is the export value of firm *i* for product *k* to country *j* at time *t*. Variables in the vector x_{ijkt} are the same as those in the equation (1). The meaning of γ_{ijk} and ν_t can be determined from the above information. Equation (2) is commonly specified as a log-linear model. We estimate it using OLS while controlling for year fixed effect and firm-product-country fixed effect.

Potential endogeneity is an unavoidable problem for both equation (1) and equation (2). For instance, while higher productivity may enhance firms' probability to export and export volume, so might exporting enhance export firms' productivity. As a result, the causality between the productivity and the export behavior of any given firm is vague, which has led to extensive research in the literature (e.g. Aw, Chuang, and Roberts, 2000; Girma, Greenaway, and Kneller, 2004; Arnold and Hussinger, 2005; De Loecker, 2007; Hahn and Park, 2010). Additionally, the decision maker might adjust the size of the firm to adapt its supply capacity to meet demand according to the economic situation in the destination markets. Simultaneity, therefore, is an issue that routinely arises. The same issue also arises in the context of export spillover variables. To alleviate these problems, we follow the work of many researchers (such as Greenaway and Kneller, 2007), lagging all explanatory variables by one year.

2.2 Variables

This paper investigates the impact of product and destination specific export spillover on the firm-level extensive and intensive margins, so there are two dependent variables used herein. For the extensive margin, export starters are identified with the help of a dummy variable taking the value *1* if a firm is exporting product *k* to country *j* in year *t* when it did not in the previous year, and taking the value *0* when a firm is not exporting product *k* to country *j* in both *t-1* and *t*. For a given firm-product-country, we might have several exporting start points. For instance, if we denote export status as *1* when a firm exports and *0* when it does not, the export status for firm *i* of product *k* to country *j* is *0110011*, and the dependent variable for firm *i* of product *k* in country *j* becomes *.1..01.*. We measure the intensive margin as the export value of the observed firm for product *k* to country *j* in year *t*. However, export value might reflect price heterogeneity across firms. The ideal way to solve this problem is to remove price difference by using firm-specific price deflators. Unfortunately, these price deflators are unavailable in China's case. Since controlling for year fixed effects can alleviate the effect of price differences between firms, we maintain export value as the explained variable in the case of intensive margin.

We next build export spillover variables. Following the existing literature (see, for example, Greenaway and Kneller, 2007, and Koenig, Mayeris, and Poncet, 2010), we construct the spillover variable by using the number of exporting firms. As information on region, product, and destination is available, we can construct several different export spillover variables with different features. For each firm and each year, the ***general spillover*** variable is constructed by counting the number of other exporting firms in the same city as the observed firm. The second spillover variable is constructed by computing the number of other exporting firms in the same city

exporting to the same destination country as the observed firm. This spillover variable captures ***destination-specific*** export spillovers. The third spillover variable captures ***product-specific*** export spillovers and is defined as the number of other firms in the same city exporting the same product as the observed firm. We define the fourth spillover variable as the number of other firms in the same city exporting the same product to the same destination as the observed firm in order to capture ***product and destination-specific*** export spillover. This spillover variable is of the most interest in our paper. In all four of these export spillover variables, the product is defined at HS6 digit level in accordance with international standards. We don't take log for spillover variables in the estimation since they can be zero.

There are some control variables in the estimation as mentioned above. As for productivity, we use labor productivity as a proxy for it; labor productivity is calculated as value added per labor. Firm size is measured by the number of laborers employed by the firm. We use the total number of employees in the prefecture as the proxy for the economic size of the area. All of these controlling variables are expressed in logs.

3. Data source and descriptive statistics

3.1 Data sources

Two sources of data are used in this paper. The first is product level trade data from 2000-2006, which is collected by China's General Administration of Customs (GAC). It contains information on products at the HS8 digit level for each firm, including trade value, export destinations, and import source countries. Statistically, more than 70% of firms export to at least two countries in the sample, and 41% of trading firms export over 5 different products. Each firm is given a unique 10-digit identifier. The first two digits represent the province where a firm is located, and the prefecture where a firm operates is indicated by the first four digits. Although trade and location information can be obtained from this data source, it does not provide information on the productivity and size of firms. We therefore use a second data source: annual surveys of manufacturing firms collected and maintained by China's National Bureau of Statistics (NBS). This dataset covers all state-owned enterprises (SOEs) and non-SOEs with annual sales more than RMB 5 million (which is equivalent to around $770,000 according to the current exchange rate).[2] Those surveys contain financial information on firms such as value added labor input. We can therefore assess labor productivity and firm size from these surveys.

Merging the trade data with the data from the surveys of manufacturing firms is necessary since variables in the estimation come from these two sources. There are two important steps required before merging these data. The first is cleaning the survey datasets which are quite noisy and are, therefore, potentially misleading. We follow the criteria provided by Brandt, Biesebroeck, and Zhang (2012) and Feenstra, Li, and Yu (2014), dropping observations as key financial

[2]Aggregated data on the industrial sector in the annual China's Statistical Yearbook by the National Bureau of Statistics are compiled from this data set.

variables missing, and the number of employees hired fewer than 10. Although there is also a unique identifier associated with each firm in the survey dataset, they are coded with a unique coding system distinct from those used in the trade survey data. It is therefore impossible to use the firm identifier to match the two datasets. Upward, Wang, and Zheng (2013) suggest that using the Chinese name of firms can serve as an effective way to match up data sets because firm names are less likely to change during the relatively short time period from 2000-2006 (7 years). Thus, we follow their suggestion to match the two sources of data. After matching, we obtain an unbalanced panel sample with firm-product-country as the individual and year as the time variable.

3.2 Descriptive statistics

Table 1 provides annual summaries of information from the matched sample. Since non-SOEs in the survey dataset are those with annual sales of $770,000 or more, the non-SOEs in the matched sample appear to be larger in scale than the small SOEs. According to Table 1, the SOEs and non-SOEs in the matched sample account for 31.49%-49.83% of the total export value, 22.12%-38.30% of the total export volume, and 25.14%-34.16% of the number of all exporting firms. The export value of the matched sample accounts for 41.15% on average of the total export, which indicates that our matched sample is representative of the full sample.

Table 2 describes the statistics for the variables used in the estimation. Labor productivity is 3.85 on average. The negative value for minimum labor productivity is a result of the procedure; this variable is expressed in log. In our sample, the maximum number of varieties a firm exports is up to 692, and each firm exports 7 different products on average. The largest number of destinations a single firm exports to is 158, and there are 8 trading partners for each firm on average. The average number of export varieties and destinations for each firm in China is lower than that in France (both figures are 11 in France as calculated by Koenig, Mayneris, and Poncet, 2010), however, the largest number of export varieties and trading partners in China are more than those in France (which are 277 and 116 respectively). The lower part of the table reports the values of the export spillover variables. We can observe that as the spillover variables become more specific, the smaller the average number of exporting firms. For example, the average number of other firms in each city is 5,363 without putting constraints on the product and destination country. However, when considering the other firms exporting the same product to the same destination, the average number of other firms in city drops to 82.

Table 3 further presents the distribution statistics of spillover variables in terms of cities. In about 71.49% of cities, the average number of neighboring firms exporting the same product to the same destination is less than 6. The cities in which the average number of neighboring firms exporting the same product to the same destination is over 30 account for 9.78% of the total number of cities. The share of cities where the average number of neighboring firms is at least 5 increases as follows: from 28.51% when the definition of spillovers is product-destination specific; to 67.97% when it is destination-specific; to 97.97% when it is product-specific; and to 99.90%

when it is defined as all products-all destinations.

Table 1 Descriptive statistics on the sample

	Share of total					
	state-owned enterprises (SOEs) and non-SOEs with above scale			Other firms		
	Export Value	Export Volume	Number of Exporters	Export Value	Export Volume	Number of Exporters
2000	31.49%	22.86%	25.14%	68.51%	77.14%	74.86%
2001	35.92%	22.12%	28.45%	64.08%	77.88%	71.55%
2002	38.34%	23.11%	28.18%	61.66%	76.89%	71.82%
2003	40.64%	27.17%	28.18%	59.36%	72.83%	71.82%
2004	49.83%	36.08%	34.69%	50.17%	63.92%	65.31%
2005	47.82%	37.14%	30.16%	52.18%	62.86%	69.84%
2006	46.75%	38.30%	29.45%	53.25%	61.70%	70.55%

Table2 Descriptive statistics on variables

Variable	Definition	Mean	Std.dev.	Min	Max
Firm size	Firm employees	5.70	1.24	2.30	11.94
Productivity	Labor productivity of firms	3.90	1.07	-5.70	11.58
Size of area	Total employment in prefecture	13.29	0.92	5.68	14.70
Import	Import same product from the same country	11.32	3.64	0.00	23.16
number_product	# of exported products	6.69	10.10	1.00	692.00
Number_country	# of destination countries	7.97	9.88	1.00	158.00
agg_city	# other firms in the city, all products-all destinations	4186.70	5362.94	1.00	25838.00
agg_city_hs	# other firms in the city, same product-all destinations	967.33	1731.16	0.00	19622.00
agg_city_cou	# other firms in the city, all products-same destination	79.91	319.39	0.00	7669.00
agg_city_hc	# other firms in the city, same product-same destination	14.51	81.61	0.00	2101.00

Note: The first four variables are taken as logs. The others are level.

Table 3 Distribution statistics of spillovers in terms of firms

# other firms in the city	City number share of total...			
	Same product-same destination	All products-same destination	Same product-all destinations	All products-all destinations
<6	71.49%	32.03%	2.03%	0.10%
6-10	9.78%	12.48%	1.44%	0.07%
11-15	4.79%	7.98%	1.57%	0.07%
16-20	2.49%	5.68%	1.51%	0.00%
21-25	1.51%	4.24%	1.37%	0.03%
26-30	1.18%	3.81%	1.44%	0.10%
>30	8.76%	33.77%	90.64%	99.64%

4. Results

4.1 Export spillovers and extensive margin of trade

Table 4 reports logit results of export spillover effects on the export decisions of firms. In order to alleviate the potential reverse causality and simultaneity issues as discussed in the section 2, all explaining variables are lagged by one year. The export spillover variable used here is product-destination specific. From left to right, we add one more variable in the estimation sequentially. All results are estimated with year fixed effects and firm-product-destination effects. It should be pointed out that controlling firm-product-destination fixed effect in the estimation allows us to account for characteristics of firms such as management ability, characteristics of local areas such as transport infrastructure, and characteristics of destination countries such as consumer preference. This will help to alleviate the problem of omitting variables.

The results in column 1 are obtained when only firm size and firm's import value of the same product from the same county are contained as explained variables in the regression. Estimated coefficients of these two variables are both positive and significant, indicating that the relationships between the probability of starting to export certain products to certain countries and these two variables are positive. The results in column 2 are obtained after adding the export spillover variable to the estimation. It is found that the estimated coefficient of the export spillover variable is positive, and statistically significant at 1% level. However, we should be cautious in attempts to explain its meaning. Since many other controlling variables haven't been included, the result also reflects the influence of other factors on decisions to start exporting certain products to certain countries. Because productivity is consistently deemed to be an important determinant to the decision to start exporting, we also add it in the regression. The result is reported in column 3. Note that after controlling for productivity the spillover variable is still positive and significant. Meanwhile, as expected, the sign of the productivity variable is significant and positive.

In column 4 we add the variable which represents the economic size of the area; the total employment in the area serves as a proxy for this figure. This variable is used to control for the labor pooling effect, because firms typically employ the best-matched labor for their needs most easily in agglomerated areas. The result shows that the economic size of the area also has positive effects on the start exporting decision. However, the inclusion of this variable does not affect the coefficient of the export spillover variable. It remains significant and positive with a coefficient equal to 0.4332, which means that the more neighboring firms export a product to a given country, the higher the probability that a given firm will export the same product to the same country. Therefore, with the controls for unobserved characteristics of product, area and country, as well as firm size, import traffic, and economic size of area, the agglomeration of exporting firms with given product and destination country has a positive impact on the decision to start exporting that product to that destination country for firms in the same city.

Table 4 Effects of product-destination-specific export spillovers on starting export

	(1)	(2)	(3)	(4)
Firm size	0.8482***	0.6839***	0.6888***	0.5598***
	（0.0041）	（0.0057）	（0.0057）	（0.0058）
Import	0.1093***	0.0700***	0.0698***	0.0406***
	（0.0012）	（0.0018）	（0.0018）	（0.0018）
agg_city_hc		0.6209***	0.6200***	0.4322***
		（0.0041）	（0.0041）	（0.0045）
Productivity			0.0001***	0.0001***
			（0.0000）	（0.0000）
Size of area				0.9583***
				（0.0094）
Year fixed effects	Yes	Yes	Yes	Yes
Firm-product-destination fixed effects	Yes	Yes	Yes	Yes
Observations	2,605,336	1,338,241	1,338,241	1,338,241

Note: Standard errors in parentheses. *** denotes significance at 1% level.

We next investigate the scope of export spillovers. Specifically, we ask whether the effect is still significant if export spillover is product-specific, or destination-specific, or neither product-specific nor destination specific (referred to as “general” herein). Table 5 reports estimated results using different export spillovers. From column 1 to column 4, the export spillover variables used are general, destination-specific, product-specific, and product-destination specific, respectively. All results are given after controlling for firm size, import traffic, area size, and unobservable characteristics of product, area, and destination country. From these results, we find that coefficients of export spillovers are all positive and significant at 1% level. If we compare the magnitude of these estimated coefficients, we observe that they decrease in value. That is, the effect of general export spillover on the start export decision is smallest. When export spillover is destination-specific or product-specific, the effect on the start export decision becomes larger. Finally, the effect is largest for product and destination specific spillover.

Table 5 Effects of different specific export spillovers on starting export

	（1）	（2）	（3）	（4）
Firm size	0.6936***	0.7004***	0.6922***	0.6262***
	（0.0043）	（0.0043）	（0.0045）	（0.0059）
Import	0.0582***	0.0608***	0.0576***	0.0388***
	（0.0012）	（0.0012）	（0.0013）	（0.0018）
agg_city	0.0002***			
	（0.0000）			
agg_city_cou		0.0004***		
		（0.0000）		
agg_city_hs			0.0005***	

			（0.0000）	
agg_city_hc				0.4212***
				（0.0045）
Productivity	0.2416***	0.2454***	0.2386***	0.1984***
	（0.0025）	（0.0025）	（0.0026）	（0.0034）
Size of area	0.8065***	0.9954***	1.2029***	0.8922***
	（0.0080）	（0.0076）	（0.0074）	（0.0095）
Year fixed effects	Yes	Yes	Yes	Yes
Firm-product-destination fixed effects	Yes	Yes	Yes	Yes
Observations	2,601,427	2,594,779	2,329,743	1,338,194

Note: Standard errors in parentheses. *** denotes significance at 1% level.

We perform several robustness checks and further investigate the geographic feature of export spillover in Table 6. The export spillover variable here is defined as product and destination specific. It might be argued that the agglomeration of firms will increase the demand for labor in the agglomeration area. With a given labor supply, increasing the demand for labor will raise wages and hence the cost for firms in the area, which will lead in turn to a decline in the start export propensity. This means that omitting wages may lead to biased estimator of export spillovers. Based on the model used in column 4 in Table 4, we include firm wages (denoted as "wage", and defined as total wages paid in the financial report divided by the number of employees) in the estimation, and the result is shown in column 1 of Table 6. The estimated coefficient of the wage is positive and significant, which might be because a firm's wage is positively correlated with its productivity. However, its inclusion does not change the sign of the coefficient of the spillover variable. It remains positive and significant at 1% level. What's more, we can observe that the size of the coefficient is close to that in the baseline regression.

In addition to intra-sectoral externalities, diversity of local activity might generate cross fertilization and improve a firm's performance (Jacobs, 1969), a trend which is also known as urbanization economics. Similarly, more export varieties might affect the propensity to start exporting for a firm in the area. To investigate how the diversity of export products manufactured in the same area affect our estimation of export spillovers, we add the number of total other exported products in the same area (denoted as "OP") in the specification used in column 4 of Table 4. Column 2 reports the estimated results. We can observe that the estimated coefficient of this variable is positive and significant as expected. This result indicates that the greater the variety of products exported in a city, the larger the effect of spillovers on export propensity. Again, the sign and significance of the coefficient on the export spillover variable remain unchanged.

Column 4 compares the effect of export spillover with product-country specific exports and that with the product specific exports only. Product-specific spillovers can be divided into two categories: firms exporting the same product to the same destination, and firms exporting the same product to other destinations. Again, in column 4 of Table 4, we add the variable measuring the number of other firms in the city exporting the same product to different destinations (denoted as "agg_city_hs_other1"). Results reveal that the coefficient of this variable is significant at 1% level, but the magnitude is relatively small, only 0.001. Meanwhile, the inclusion of this variable doesn't affect the sign and significance of the coefficient of the export spillover variable with regard to product-destination specific exports. The only change is the magnitude of the coefficient, which

decreases from 0.4322 to 0.3198. Although the coefficient can't be explained as the marginal effect on the export propensity, it has a positive impact on export propensity. With this in mind we can conclude that product and destination specific export spillover has a stronger impact on start export propensity than does product specific export spillover.

The last column of Table 6 explores the geographical scope of export spillovers. In the same specification as column 4 of Table 4, we have two additional spillover variables computed at different geographical scales. They are the number of firms outside a city but within the same province as the target firm (denoted as "agg_city_hc_other"), and the number of firms in China but with different provinces than the observed firm (denoted as "agg_province_hc_other"). One more point which must be emphasized is that all the other firms considered are those exporting the same product to the same destination as the observed firm. While the coefficient of export spillover variable within the province is positive and significant at 1% level, the effect of export spillover variable outside the province (that is agg_province_hc_other) is insignificant. Comparing the estimated coefficients of the export spillover variable within the city and that of the export spillover variable outside the city but within the same province, we find that the spillover effect is much larger among export firms located in the same city than from those located outside the city but within the province. These results indicate that the effect of export spillover exhibits a spatial decay pattern.

Table 6 Robustness Checks on starting export

	（1）	（2）	（3）	（4）
Firm size	0.6085***	0.5997***	0.6271***	0.6012***
	（0.0065）	（0.0066）	（0.0059）	（0.0066）
Import	0.0400***	0.0248***	0.0388***	0.0300***
	（0.0019）	（0.0020）	（0.0018）	（0.0020）
Wage	0.2008***			
	（0.0060）			
OP		0.0016***		
		（0.0000）		
agg_city_hs_other1			0.0001***	
			（0.0000）	
agg_city_hc_other				0.3306***
				（0.0052）
agg_province_hc_other				0.0004
				（0.0000）
agg_city_hc	0.4352***	0.3198***	0.4171***	0.5881***
	（0.0048）	（0.0052）	（0.0046）	（0.0061）
Productivity	0.2068***	0.1683***	0.1990***	0.1828***
	（0.0037）	（0.0037）	（0.0034）	（0.0037）
Size of area	0.9280***	0.4378***	0.8771***	0.8579***
	（0.0105）	（0.0141）	（0.0099）	（0.0119）
Year fixed effects	Yes	Yes	Yes	Yes
Firm-product-destination fixed effects	Yes	Yes	Yes	Yes

Observations	1,202,373	1,118,090	1,338,194	1,107,194

Note: Standard errors in parentheses. *** denotes significance at 1% level.

Selection bias might exist in our estimation due to the use of a specific sample of firms. In order to ease the concern of the sample selection issue, which may potentially bias the basic results, we use a variety of different sub-samples to estimate the specification of column 4 in Table 4 to show the robustness of our results.

Table 7 presents results of samples with different firm sizes. In particular, we divide firms into large scale and small scale according to their number of employees. In the first two columns, the critical value used to define large scale firms and small scale firms is the average number of employees in the industry. If the number of employees in a firm is larger than the average of the industry it belongs to, it is a large scale firm. Otherwise, it is a small scale firm. In column 3 and 4 we change the critical value to be the median number of employees in each industry. The sample used to obtain results in column 3 consists of firms whose number of employees is higher than the industry median. The firms with number of employees below the industry median are used to obtain results in column 4. Our results do not suggest any distinct heterogeneity of the spillover effect based on firm size. That is, the effects of export spillover are always significant and positive regardless of the subsamples constructed by using different cutoffs related to firm size. However, the results indicate that the export spillover effect is stronger on the export propensity of small firms than it is on the export propensity of large scale firms. One possible explanation is that it is more difficult for small scale firms to cover exporting entry costs by themselves than it is for large scale firms to manage this hurdle to exporting. As such, when export spillovers help reduce the entry costs, they have more significant effect on small scale firms.

Table 7 Export spillover effects on start export decisions for firms of different sizes

	Large scale	Small scale	Large scale	Small scale
Firm size	0.8259***	0.3955***	0.7699***	0.1439***
	（0.0115）	（0.0123）	（0.0092）	（0.0151）
Import	0.0040***	0.0392***	0.0405***	0.0377***
	（0.0032）	（0.0037）	（0.0026）	（0.0051）
Productivity	0.2029***	0.2483***	0.2083***	0.2260***
	（0.0067）	（0.0069）	（0.0053）	（0.0088）
Size of area	1.0452***	1.5224***	1.0697***	1.0862***
	（0.0182）	（0.0236）	（0.0150）	（0.0321）
agg_city_hc	0.4221***	0.5118***	0.4371***	0.4859***
	（0.0075）	（0.0091）	（0.0061）	（0.0127）
Year fixed effects	Yes	Yes	Yes	Yes
Firm-product-destination fixed effects	Yes	Yes	Yes	Yes
Observations	466,299	326,803	696,473	157,693

Note: Standard errors in parentheses. *** denotes significance at 1% level.

In Table 8, we find that the influence of export spillovers does not depend on the variety of products exported by firms. We have three definitions to distinguish single product firms and multi product firms. The first definition states that firms exporting only one variety are called single product firms, and all others are called multi-product firms. The second definition states that firms with one main export accounting for more than 50% of their total export value are defined as

single product firms, and all others are called multi-product firms. In the third definition, we change the cutoff from 50% to 75%. That is, we define firms with one main export accounting for more than 75% of their total export value as single product firms. From left to right, samples within each set of two columns corresponds to these three definitions, respectively. According to estimated results, we again find that coefficients of export spillovers are all positive and significant at 1% level for both single product and multi-product firms, and for all different classifications. Comparing the magnitude of estimated coefficients for multi-product firms and single product firms, we find that single product firms benefit more from export spillovers than multi-product firms. The reason for this might be that multi-product firms can cover the entry costs more easily than single product firms, since the export of other products within the firm can provide information about the international market. The results above imply that our results for exporting spillover effect are very robust, and exhibit only trivial variations across different subsamples.

Table 8 Export spillover effects on start export decisions of firms with different varieties of products

	Single product	Multi products	Single product	Multi products	Single product	Multi products
Firm size	0.4685***	0.5867***	0.6668***	0.5184***	0.6940***	0.2785***
	（0.0623）	（0.0070）	（0.0097）	（0.0132）	（0.0142）	（0.0314）
Import	0.0295*	0.0384***	0.0396***	0.0348***	0.0415***	0.0315***
	（0.0171）	（0.0022）	（0.0031）	（0.0039）	（0.0044）	（0.0096）
Productivity	0.2407***	0.2114***	0.2402***	0.2272***	0.2644***	-0.0042**
	（0.0380）	（0.0042）	（0.0057）	（0.0083）	（0.0084）	（0.0212）
Size of area	1.5154***	0.9651***	1.0281***	0.7140***	1.3782***	1.1978***
	（0.1174）	（0.0125）	（0.0173）	（0.0233）	（0.0256）	（0.0648）
agg_city_hc	0.3823***	0.4363***	0.4178***	0.4478***	0.4082***	0.5228***
	（0.0493）	（0.0052）	（0.0072）	（0.0097）	（0.0107）	（0.0246）
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm-product-destination fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,451	939,160	518,134	246,844	244,444	352,700

Note: Standard errors in parentheses. *** denotes significance at 1% level.

4.2 Export spillovers and intensive margin of trade

This part mainly examines the impact of export spillovers on firm-level intensive margins of exports. In the sample, all firms export at least one product to one country. Year fixed effects and firm-product-destination fixed effects are controlled for in each regression. Results are reported in Table 9-12.

The first four columns provide baseline results for product and destination specific export spillover variables. These results are obtained in a similar way as those in Table 4 for the extensive margin. We begin with only two control variables in the estimation, adding more variables in the following regressions, and ending with our preferred specification in column 4. Results show that coefficients of export spillover variable are significantly positive in all specifications. This implies that a firm's exporting value will increase if there are more nearby exporting firms. The last two columns investigate the specific nature of the export spillover effect. In column 5, we substitute

the product and destination specific export spillover measure by the measure of product specific spillover. It is found that the estimated coefficient of export spillover is still positive and significant, but the spillover effect of product specific exports is smaller than that of product and destination specific exports. We get similar results when we substitute the product and destination specific export spillover measure with the measure of destination specific spillover in column 6; these results again reveal that the firm-level intensive margin of exports benefits most from product and destination specific export spillovers.

Table 10 presents robustness checks similar to those in Table 6. The first column adds wage as a control variable. The second column adds export varieties into the baseline specification. The third column adds the number of other exporting firms in the city exporting the same product to different destination countries. These results reveal that the effects of export spillover on export value are positive and significant in different regressions. The last column examines the geographical scope of export spillover effects in order to test the feature of spatial decay. In addition to using the number of other firms exporting the same product to the same destination within the city, we also include the number of firms outside the city but within the province, and the number of firms outside the province but within China. Although the coefficient of the number of firms outside the city but within the province is insignificant, it is larger than the coefficient of the number of firms outside the province but within China. Again, the coefficient of the number of other firms within the city is the largest among the three export spillover variables. This indicates a clear spatial decay feature of the spillover effect on the firm-level intensive margin of exports.

Table 9 Effects of product-destination-specific export spillovers on export value

	（1）	（2）	（3）	（4）	（5）	（6）	（7）
Firm size	0.2538***	0.1426***	0.1607***	0.1482***	0.1957***	0.2088***	0.2179***
	（0.0061）	（0.0070）	（0.0071）	（0.0073）	（0.0066）	（0.0066）	（0.0066）
Import	0.0241***	0.0062***	0.0053**	0.0035	0.0100***	0.0117***	0.0119***
	（0.0019）	（0.0022）	（0.0022）	（0.0022）	（0.0019）	（0.0019）	（0.0019）
agg_city					0.0002***		
					（0.0000）		
agg_city_cou						0.0003***	
						（0.0000）	
agg_city_hs							0.0003***
							（0.0000）
agg_city_hc		0.2198***	0.2114***	0.1980***			
		（0.0053）	（0.0054）	（0.0057）			
Productivity			0.0443***	0.0402***	0.0595***	0.0655***	0.0683***
			（0.0040）	（0.0041）	（0.0036）	（0.0036）	（0.0037）
Size of area				0.1004***	0.1801***	0.2561***	0.3346***
				（0.0135）	（0.0124）	（0.0119）	（0.0115）
Constant	5.7471***	6.5948***	6.3432***	5.1174***	3.3750	2.3396***	1.1354***
	（0.0400）	（0.0452）	（0.0507）	（0.1723）	（0.1604）	（0.1521）	（0.1458）
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-product-destinatio fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Observations	1,492,979	1,117,458	1,117,458	1,1117,458	1,492,457	1,490,500	1,430,532

Note: Standard errors in parentheses. *** denotes significance at 1% level.

Table 10 Robustness Checks on export value

	（1）	（2）	（3）	（4）
Firm size	0.1384***	0.1375***	0.1475***	0.1394***
	（0.0080）	（0.0077）	（0.0074）	（0.0076）
Import	0.0043*	0.0021	0.0035	0.0028
	（0.0023）	（0.0023）	（0.0022）	（0.0023）
Wage	0.0448***			
	（0.0074）			
OP		0.0001***		
		（0.0000）		
Lagg_city_hs_other1			0.0001	
			（0.0001）	
Lagg_city_hc_other				0.0091
				（0.0061）
Lagg_province_hc_other				0.0000**
				（0.0000）
Lagg_city_hc	0.1998***	0.1846***	0.1963***	0.1951***
	（0.0060）	（0.0062）	（0.0058）	（0.0072）
Productivity	0.0421***	0.0339***	0.0400***	0.0354***
	（0.0044）	（0.0042）	（0.0041）	（0.0042）
Size of area	0.1275***	0.1818***	0.0968***	0.2080***
	（0.0146）	（0.0193）	（0.0137）	（0.0174）
Constant	4.6492***	3.9358***	5.1690***	3.7238***
	（0.1843）	（0.2340）	（0.1752）	（0.2202）
Year fixed effects	Yes	Yes	Yes	Yes
Firm-product-destination fixed effects	Yes	Yes	Yes	Yes
Observations	997,484	1,068,164	1,117,458	1,063,302

Note: Standard errors in parentheses. *** denotes significance at 1% level.

Finally, we check whether our baseline results for export value remain unchanged for different subsamples. Table 11 reports results based on a subsample of large scale firms and small scale firms. Table 12 report results based on a subsample of single product firms and multi-product firms. Definitions for different types of firms are the same as given in the previous part. The results exhibit stable features again; that is, for all different subsamples, the sign and significance of coefficients on export spillovers are all the same as the baseline results. This indicates that the effect of export spillover on export value is also robust for different subsamples. Distinct from the export spillover effect on the firm-level export propensity, the effect on the firm-level intensive margin of exports is stronger for large firms and single product firms. One possible explanation is that both large firms and single product firms tend to benefit more from sharing freight.[3] As a result, the spillover effect results exhibits a stronger pattern for these firms.

[3] The reason large firms benefit more might be because they export to the same destination frequently in the same year and therefore can benefit more from sharing transportation costs with nearby firms. Compared with

Table 11 Export spillover effects on export value for firms with different sizes

	Large scale	Small scale	Large scale	Small scale
Firm size	0.1429***	0.1051***	0.1537***	0.1000***
	（0.0113）	（0.0132）	（0.0093）	（0.0168）
Import	0.0051	0.0030	0.0028	0.0082
	（0.0032）	（0.0037）	（0.0027）	（0.0053）
agg_city_hc	0.1991***	0.1973***	0.2056***	0.1864***
	（0.0083）	（0.0097）	（0.0069）	（0.0138）
Productivity	0.0353***	0.0349***	0.0452***	0.0136
	（0.0067）	（0.0063）	（0.0052）	（0.0083）
Size of area	0.1660***	0.1020***	0.1542***	0.0153***
	（0.0201）	（0.0024）	（0.0165）	（0.0312）
Constant	4.1143***	5.4882***	4.2614***	6.7522***
	（0.2533）	（0.3075）	（0.2088）	（0.4122）
Year fixed effects	Yes	Yes	Yes	Yes
Firm-product-destination fixed effects	Yes	Yes	Yes	Yes
Observations	562,874	434,820	798,191	319,267

Note: Standard errors in parentheses. *** denotes significance at 1% level.

Table 12 Export spillover effects on export value for firms with different variety of products

	Single product	Multi products	Single product	Multi products	Single product	Multi products
Firm size	0.2230***	0.1458***	0.1594***	0.1288***	0.2006***	0.1039***
	（0.0372）	（0.0076）	（0.0098）	（0.0139）	（0.0136）	（0.0324）
Import	-0.0101	0.0035	0.0073**	0.0031	0.0101***	0.0036
	（0.0104）	（0.0023）	（0.0029）	（0.0042）	（0.0038）	（0.0098）
agg_city_hc	0.2532***	0.1937***	0.2256**	0.1651***	0.2365***	0.1121***
	（0.0304）	（0.0059）	（0.0077）	（0.0105）	（0.0108）	（0.0252）
Productivity	0.0413**	0.0393***	0.0367***	0.0442***	0.0601***	0.0215
	（0.0193）	（0.0043）	（0.0054）	（0.0080）	（0.0074）	（0.0186）
Size of area	0.2883***	0.0885***	0.1499***	0.0629***	0.1944***	-0.1419*
	（0.0563）	（0.0142）	（0.0174）	（0.0027）	（0.0240）	（0.0747）
Constant	4.0981***	5.2137***	4.4834***	5.5087***	3.7847***	8.7611***
	（0.7325）	（0.1816）	（0.2228）	（0.3410）	（0.3054）	（0.9726）
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm-product-destination fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	53,433	1,064,025	697,987	422,477	375,402	87,314

Note: Standard errors in parentheses. *** denotes significance at 1% level.

multi-product firms, single product firms less capable of bundling their products and therefore benefit more from sharing freight with other firms.

5. Conclusion

This paper investigates the role the agglomeration of local exporters plays in improving the exporting performance of firms using a detailed dataset of Chinese exports by firm, product, year, and destination country from 2000-2006. In theory, export spillover might decrease fixed and variable costs, which will help firms enter into the foreign market, and also enhance their export scale. Unlike previous studies on Chinese exporters that focus only on the export decision and spillover from FIEs, or on all firms including those which do not export, in this study we take export scale into account and focus on various types of exporters.

Our results show that the agglomeration of firms exporting the same product to the same destination has positive effects at the firm-level on both the extensive margin and intensive margin of exports. These results are robust to the standards of different model specifications and subsamples used in estimations. Hence, we believe that export spillovers can reduce not only the fixed cost to export, but also the variable cost in local areas. Although the agglomeration of general exporters has a positive impact on export propensity and export value, the effect of product and destination specific agglomeration of exporters is strongest. These results suggest that the knowledge spillover from agglomeration of exporters is shaped in important ways by technological and destination proximity. In addition, we find that the effect of agglomeration of exporters exhibits spatial decay. This feature implies that the exporting spillover effect is strongest from exporting firms within the same city, followed in strength by firms outside the city but within the province, and weakest from firms outside the province but still in China. Finally, this research finds that small firms and multi-product firms benefit more from export spillovers in terms of extensive margin, while large firms and single product firms gain more in terms of intensive margin.

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