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Does Agglomeration Promote the Internationalization of Chinese Firms?[*]

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Abstract

This study empirically examines the role of agglomeration in enabling firms to begin exporting, using a large dataset of Chinese firms. Knowledge spillover caused by the agglomeration of exporters can reduce the initial cost of export, thereby lowering the "productivity cut-off" required to export. A parametric estimation of an export entry model indicates that the agglomeration of incumbent exporters contributes significantly to export participation, although its magnitude is limited. These spillover effects are generated not only by the agglomeration of exporting foreign invested firms (FIFs), but also, more importantly, by that of indigenous Chinese exporters. In fact, the agglomeration of exporting FIFs only contributes to the export entry of FIFs, yet has a negative impact on indigenous Chinese firms' export participation.

Keywords: Agglomeration, Export, Productivity, Nonparametric tests
JEL classification: F1, F14

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1. Introduction

Exporting is associated with non-negligible initial costs that cannot be recovered. Therefore, firms that are not sufficiently productive—and thus cannot capture enough profit to cover the costs—are prevented from accessing foreign markets. Exporting can often provide firms with an opportunity for rapid growth and innovation.[1] Case studies report that, by exporting, prominent Chinese firms such as Lenovo or Huawei acquired a cash flow and advanced technology that enabled rigorous new product development targeted to the domestic market [7]. Global engagement by more Chinese firms is still important for China as it seeks economic growth led by innovation and domestic consumption, because of the close link between exports and innovation. Therefore, understanding the nature of such sunk entry cost, and how it can be reduced, is an important policy agenda. Some studies argue that the entry cost of exports is primarily based on knowledge-intensive expenditures required to penetrate foreign markets, such as research on foreign demand, establishment of networks, and development of new products preferable to foreign consumers [8,9]. If this is the case, knowledge spillover from more experienced exporters—such as multinational enterprises (MNEs)—can play a substantial role in reducing the initial costs faced by potential entrants. However, because of the localized nature of knowledge spillover [10], potential entrants operating in proximity to the incumbent exporters are more likely to enjoy the externality. This gives rise to our research question: does the agglomeration of export activity, such as that observed in special economic zones in China, promote the export entry of less productive firms?

Some studies have explored export spillover associated with agglomeration. For instance, while Clerides, Lach, and Tybout [8]; Greenaway and Kneller [9]; and Koenig [11] found that an increased geographic concentration of exporters aided export entry by Columbian, UK, and French firms, Aitken, Hanson, and Harrison [12]; Barrios, Gorg, and Strobl [13]; and Bernard and Jensen

[1] See for instance [1,2,3] for evidence of increased productivity growth after export entry by Sub-Sahara African, Slovenian, and Chinese firms (excluding the foreign invested enterprises). See [4,5,6] for examples of innovation resulting from exporting.

[14] concluded that the effect was not significant in case of Mexican, Spanish, and American firms. Surprisingly, such research remains very limited for China, even though it experienced a sustained increase in industrial agglomeration driven by exports and inward foreign direct investment (FDI) [15,16]. Few existing studies on export spillover in China are focused on the role of foreign invested firms (FIFs) in the creation of new trade linkages by domestic Chinese firms [17,18]. They, therefore, do not address the potential contribution of industrial agglomeration beyond the spillover from FIFs. For instance, they do not investigate possible spillover by the agglomeration of indigenous Chinese exporters, which have a very different internationalization process than FIFs. The assessment of export spillover should, therefore, be more comprehensive, incorporating the possible role of domestic exporters as well as MNEs.

Hence, we conduct a parametric and a nonparametric analysis to determine whether agglomeration rewards Chinese firms with lower export entry costs. Because there are many measures of industrial agglomeration, we employ two indices in our analysis to enable comparison with previous studies. Specifically, we use the Location Quotient (LQ) index, which is widely used in economic geography literature, and the number of exporters in the same region and industry as observed by Greenaway and Kneller [9]. We find that the productivity distribution of exporters in agglomerated regions is first-order stochastically dominated by that of nonexporters in agglomerated regions. This indicates that firms with relatively low productivity tend to enter export markets in agglomerated regions. Furthermore, our parametric model of export entry decision-making indicates that agglomeration is indeed a significant factor contributing to higher probability of exporting. However, the complex nature of the impact of agglomeration is revealed once we consider the ownership of the incumbent exporters and potential export entrants. For instance, we find that while the agglomeration of indigenous exporters contributes positively to export entry by both indigenous firms and FIFs, the agglomeration of exporting FIFs has a negative impact on the export participation of indigenous firms. Furthermore, we find that the spillover of agglomeration is larger for firms located in inland China than for those in the coastal region. Our result indicates that promoting knowledge spillover among indigenous exporters is a useful approach in expanding the number of globalized firms in China. The agglomeration of indigenous exporters is a promising conduit of such spillover because knowledge spillover is often localized.

The remainder of this paper is organized as follows. The next section presents a literature review and our motivation for conducting the analysis. Section 3 describes our data and empirical strategy. Section 4 presents the results of the nonparametric and parametric analyses. Section 5 concludes the study with policy implications.

2. Related studies

Since the seminal works by Clerides, Lach, and Tybout [8] and Roberts and Tybout [19] the existence of large, nonrecoverable initial costs has been considered as an important factor in a firm's decision-making to export. Studies in international economics that emphasize the heterogeneity among firms indicate that only firms with sufficient productivity earn enough to afford sunk entry costs and to thereby start exporting [20,21]. The minimum level of productivity required to earn profit from exports—referred as "productivity cut-off"—is primarily a function of this sunk cost and the *ad-valorem* trade cost. On the basis of the self-selection into export by the firms with productivity above the cut-off,—it can be observed that exporting firms demonstrate a marked superiority over those serving only domestic market in size, productivity, and labor compensation [22,23,24].

While the existence of entry cost to exports has profound implications for policies promoting the globalization of firms, the nature and essence of these costs have only been explored to limited extent. For instance, Clerides, Lach, and Tybout [8] suggested that this type of sunk cost is associated with a firm's need to research foreign demand and competition, establish distribution channels, and adjust their product characteristics and packaging to adapt to the preference of foreign consumers. The view that export entry costs represent expenditures for necessary knowledge-based capital for new business is supported by studies that explore the relation between exports and innovation. For example, Barrios, Gorg, and Strobl [13] as well as Cassiman, Golovko, and Martinez-Ros [25] observed, from panel data on Spanish enterprises, that previous R&D intensity and product innovation are important determinants of whether a firm will export. Bernard and Jensen [14], using a large panel dataset on U.S. firms, found that firms that moved into new industries in the past two years have higher probability of exporting.[2]

If the entry cost of export primarily results from the acquisition of knowledge related to overseas activities, a firm may enjoy positive spillover from other firms possessing richer knowledge. For instance, MNEs are often considered to be the source of such knowledge spillover. MNEs have knowledge and experience of operating in foreign markets, know-how in managing international marketing, distribution, and servicing of their products. The knowledge spillover from MNEs to domestic firms can lower export entry costs, thereby increasing the probability that a firm will begin to export. However, this positive externality requires a geographic proximity to experienced exporters because knowledge spillover is highly localized [10]. Aitken, Hanson, and Harrison [12] conducted one of the first empirical investigations on export spillover. Using the data of Mexican manufacturing plants, they found that the local concentration of export activity by MNEs increases domestic firms' propensity to export. Swenson [17] observed from China's city-level customs data that the presence of multinationals within a city is associated with the exports of a new HS-8 digit product by domestic private firms.

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[2] Such innovation activity may also be induced by export entry itself, which promises additional return from foreign markets [4,6].

Note that knowledge spillover is not the only benefit associated with the geographic concentration of export activity. The agglomeration of industrial activity is considered to generate a Marshalian externality that arises from the pooling of skilled labor and sharing of intermediate inputs. This externality results in an increase in productivity for all companies located in the agglomerated region. Moreover, such externality may reinforce the spillover of knowledge related to exporting, if such knowledge is transferred by skilled workers or embodied in intermediate inputs. Conversely, there is a possible negative externality that can arise from congestion in labor and intermediate goods markets as well as in the administration process. This drives up the costs of exports and productivity cut-off. Previous studies on spillover associated with agglomeration of exporting activity reported mixed results: Clerides, Lach, and Tybout [8]; Greenaway and Kneller [9], and Koenig [11], using firm-level panel data, found a positive impact of Columbian, UK, and French firms on export entry. However, Aitken, Hanson, and Harrison[12]; Barrios, Gorg, and Strobl [13]; and Bernard and Jensen (2004) [14] concluded that there was no significant effect in the case of Mexican, Spanish, and American firms.

The agglomeration of industrial activity in China has increased consistently since the mid-1990s, driven by the globalization of the Chinese economy. Major exporting industries (such as textiles and electronics) as well as industries depending heavily on imported intermediate goods (such as machinery) were strongly concentrated in coastal areas, where easy access to trade routes created larger markets and facilitated the transfer of advanced technology [15]. While this trend was somewhat discouraged by local authorities' attempt to shield industries from inter-regional competition, the overall degree of agglomeration has significantly increased from the late 1990s to the present [21,26]. Despite the close interaction between industrial agglomeration and globalization in China, studies on the role of agglomeration in the internationalization of Chinese firms remain surprisingly scarce. As an exception, Ge [10] reported that an industry's export intensity and foreign capital share have a positive and significant effect on the degree of agglomeration captured by the Ellison and Glaeser [27] index.

Existing studies on export spillover in China have focused on the spillover from MNEs. For example, Mayneris and Poncet [18] found that the probability of domestic firms in a province to export a specific product to a specific destination is higher when the FIFs in the same province export the same product to the same destination. They interpreted this as the "demonstration effect," whereby FIFs facilitate the export entry of indigenous exporters. While such studies deepen our understanding of the nature of knowledge spillover from MNEs in China, they do not fully examine the contribution of industrial agglomeration. In particular, they do not address the possible effect of agglomeration of indigenous Chinese exporters. China now boasts numerous indigenous exporters with significant accumulated experience in foreign markets. Case studies illustrate that the globalization process of those firms is very different from that of FIFs that dominate China's processing trade.[3]

This paper, therefore, takes a more comprehensive approach to assess the contribution of agglomeration to export entry of domestic Chinese firms. We employ a nonparametric approach to observe whether Chinese exporters enjoy lower export entry costs in an agglomerated region. We also model Chinese firms' decision to export, and explicitly incorporate the agglomeration following the approach by Greenaway and Kneller [9].

3. Data and empirical strategy

3.1. Data

Our empirical analysis is based on firm-level data retrieved from a statistical survey conducted by the National Bureau of Statistics of China (NBS): the *Industry Statics Data for*

[3] See, for instance, Breznitz and Murphree [7] for case studies of globalization strategy by indigenous firms operating in Beijing, Shanghai, and Pearl River Delta region.

State-owned and Non-state-owned Industrial Enterprises above a Designated Size. We use this data to determine firms' exporting status and to compute their productivity level. As the first step of our research, we observe the systematic difference in productivity distribution in terms of two dimensions: exporters versus nonexporters and firms in agglomerated location versus those in nonagglomerated location. An "exporter" is simply defined as a firm that reports positive value of exports. An agglomerated area is defined as a location with its LQ exceeding 1. The LQ of industry *i* in region *j* is computed as follows:

$$LQ_{ij} = \frac{x_{ij}/X_j}{x_i/X} \qquad (1)$$

where x_{ij} is the output of industry *i* in region *j*, x_i is the output of industry *i*, X_j is the output in region *j*, and X is the total output in China. In this analysis, industry *i* denotes the 3-digit industry classification and region *j* indicates a city in China. As for productivity, we estimate the firm-level total factor productivity (TFP) computed as part of the real value-added, which is unexplained by labor contribution and capital input within the estimated Cobb-Douglas production function.[4] Data on value-added, labor input (the number of regular workers), and capital stock (the net value of fixed assets of domestic firms) are all retrieved from the survey, and deflated by the producer price index at the industry level, also published by the NBS.

3.2. Nonparametric test

Several studies have examined the association between the selection of firms and their geographical agglomeration. In a study on the relation between sorting of firms based on the theory

[4] We estimate firm-level TFP by Levinsohn and Petrin [29] taking into account the endogeneity problem in production function.

of firm heterogeneity and geographical selection, Baldwin and Okubo [30] showed that highly productive firms can choose to locate in large and competitive markets because they are more profitable and mobile. As a result, a large market where the competition is tough leads to a selection of highly productive firms. Similarly, Melitz and Ottaviano [31] showed that a large market makes competition tougher by attracting firms to locate in the market, and leads to the exit of less productive firms. Combes et al. [32] generalized the framework of Melitz and Ottaviano [31] and combined the model with the general theory of economic geography by Fujita and Ogawa [33] and Lucas and Rossi-Hansberg [34], and predicted two properties. First, a stronger selection in larger cities leads to a greater left truncation of productivity distribution as a tough competition forces less-productive firms to exit. Second, positive agglomeration effects in larger cities lead to a greater rightward shift of productivity distribution. Although several studies have examined the selection of firms in large markets or cities, namely agglomerated regions, little attention has been paid to firm heterogeneity and trade compared with agglomeration effects. If the agglomeration of exporters generates a knowledge spillover needed to export, the initial cost of export is smaller in agglomerated regions, which implies a lower productivity cut-off. We, therefore, expect to find less difference between the productivity distribution of exporters and domestic firms in the agglomerated region than in nonagglomerated regions. We examine this formally by comparing the productivity distribution of the two types of exporters by a nonparametric Kolmogorov–Smirnov (KS) test. This is a rigorous test that better identifies productivity differences than the mere comparison of mean productivity. This is because it considers all moments of the distribution. The KS test allows us to compare the overall productivity distribution of firms by its export status and location, on the basis of the concept of first-order stochastic dominance. Let $F(\theta)$ be the distribution of productivity of a specific group. First-order stochastic dominance of $F_1(\theta)$ with respect to $F_2(\theta)$ is defined as $F_1(\theta) - F_2(\theta) \leq 0$, uniformly in $\theta \in \Re$, with strict equality for some θ. We conduct both one-sided and two-sided KS tests in order to examine the stochastic dominance. The two-sided KS test examines whether both distributions, $F_1(\theta)$ and $F_2(\theta)$, are identical. The null and alternative hypotheses can be expressed as

$H_0: F_1(\theta) - F_2(\theta) = 0$ for all $\theta \in \Re$ vs. $H_1: F_1(\theta) - F_2(\theta) \neq 0$ for some $\theta \in \Re$.

The one-sided test of stochastic dominance can be formulated as

$H_0: F_1(\theta) - F_2(\theta) \leq 0$ for all $\theta \in \Re$ vs. $H_1: F_1(\theta) - F_2(\theta) > 0$ for some $\theta \in \Re$.

If the null hypothesis for the two-sided test is rejected and that for the one-sided test is accepted, we can conclude that $F_1(\theta)$ stochastically dominates $F_2(\theta)$. We conduct the KS test separately for each year to avoid a possible violation of the independence assumption. We compare the distribution of productivity among the four types of Chinese firms: domestic firms in nonagglomerated locations, domestic firms in agglomerated locations, exporters in nonagglomerated locations, and exporters in agglomerated locations.

3.3. Parametric test: a model of export entry

The second step of our research is to evaluate the contribution of export agglomeration to the likelihood of export participation within a parametric framework. Following Greenaway and Kneller [9], we model a firm's decision to export as the following Probit function:

$$y^*_{ijkt} = \mathbf{X}_{it}\boldsymbol{\beta} + \mathbf{Z}_{jkt}\boldsymbol{\gamma} + e_{ijkt} \qquad y_{ijk} = \begin{cases} 1: \text{Exporter} & if \quad y^*_{ijk} > 0 \\ 0: \text{Non-exporter} & if \quad y^*_{ijk} \leq 0 \end{cases} \tag{2}$$

where suffixes *i*, *j*, *k*, and *t* denote the firm, industry, region, and year, respectively. y^*_{ijkt} is a latent variable and y_{ijkt} is a binary variable equal to one if firm *i* in industry *j* located in region *k* exports, and 0 otherwise. e_{ijkt} is the error term. The value of the latent variable is determined by a set of firm-specific regressors $\mathbf{X}_i$, and a set of industry- and region-specific regressors containing agglomeration variables $\mathbf{Z}_{jk}$.

The following firm characteristics, often employed in previous studies, are included in $\mathbf{X}_i$: a firm's TFP, number of employees as a measure of size, and its wage level as a measure of skill. These explanatory variables are transformed by taking the natural logarithm, and are lagged one year to avoid simultaneity problems between the explanatory variables and the error term. We also control for the "hysteresis effect" in exporting by adding a dummy variable expressing the exporting status in the previous year. Furthermore, we include year dummy variables; 3-digit industry dummy variables; and regional dummy variables, which are set at the county level in China.[5]

The key variables of this study represent the agglomeration of incumbent exporters, included in the vector $\mathbf{Z}_{jk}$. Following Greenaway and Kneller [9], we capture agglomeration by the number of incumbent exporters and observe the spatial and industrial aspects of agglomeration. These aspects are captured by the number of exporters located in the same county and belonging to the same industry (agg1_1) and the number located in the same county but belonging to different industries (agg1_2). We also evaluate whether the export spillover differs depending on the ownership of the incumbent exporters and the location of agglomeration, by observing the following four agglomeration variables: the number of indigenous exporters located in the same county (agg2_1), the number of indigenous exporters located in the same province but in different counties

[5] In China, regions are classified at several levels. The first level is the central government. The second is the provincial level, which consists of 31 provinces in Mainland China. The third is the prefectural level, which is not used frequently, and each province includes approximately six prefectural regions. The fourth is the county level; there are more than 2000 counties. The sample used in the regression covers 714 counties, where the firms above a designated scale operate and the all-explanatory variables are available.

(agg2_2), the number of exporting FIFs located in the same county (agg3_1), the number of exporting FIFs located in the same province but in different counties (agg3_2). Table 3 summarizes the basic statistics for each variable in 2000 and 2007.[6]

INSERT Table 1 Here

4. Empirical results

4.1. KS tests

This section shows the results of the KS tests, where productivity is compared between the four groups of firms: (i) nonexporters located in nonagglomerated regions, (ii) nonexporters located in agglomerated regions, (iii) exporters located in nonagglomerated regions, and (iv) exporters located in agglomerated regions. Before presenting the results of the KS tests, we graphically examine the probability distribution functions (PDFs) of TFP by exporting and location status. Figure 1 displays the PDF of TFP. Interestingly, the TFP distributions of exporters are located on the left-hand side of domestic firms for both agglomerated and nonagglomerated regions. In terms of location aspects, firms' productivity distributions in agglomerated regions are located on the right-hand side in nonagglomerated regions. This suggests effects from tough competition and agglomeration. This suggests that (i) average exporters are less productive than domestic firms, and (ii) all firms located in agglomerated regions benefit from agglomeration.

INSERT Figure 1 Here

Table 2 presents the nonparametric KS test statistics for group A firms versus group B firms.

[6] The data used for the estimation cover all data from 2000 to 2007, although the table shows only the summary statistics of the regressors for the years 2000 and 2007. The number of full observations with accurate information on the variables of interest is 734,878.

First, from the results of the two-sided tests, we cannot reject the null hypothesis of identical productivity distributions for group A firms relative to group B firms for all combinations. Furthermore, the one-sided tests between groups A and B for both directions clarify which productivity distribution stochastically dominates the other. Panel (a) shows that the productivity distribution of domestic firms located in nonagglomerated regions stochastically dominates that of exporters in the same region, with exceptions in 2001 and 2002. Furthermore, as shown in panel (b), domestic firms' productivity stochastically dominates that of exporters in agglomerated regions. Panel (c) corresponds to the tests on productivity distribution in agglomerated and nonagglomerated regions. It can be observed that the productivity distribution of exporters located in agglomerated regions stochastically dominates that of exporters in nonagglomerated regions, which supports the positive agglomeration effect. Last, panel (d) indicates that a similar stochastic dominance is observed between domestic firms in agglomerated and nonagglomerated regions.

The results showing the stochastic dominance of domestic firms in terms of productivity are inconsistent with the theoretical prediction by Melitz [20]. Although export spillover generated in an agglomerated region may contribute to the results as we expected, this inconsistency is also found in nonagglomerated regions.[7] This may be due to the large role of processing exports regime and FIFs in China's exports. The fixed costs of processing exports are not necessarily higher than local sales costs. Beside the advantageous administrative treatments enjoyed against domestic firms, FIFs are more informed about foreign markets than domestic firms. It is likely that FIFs can access foreign markets more easily than indigenous firms.[8] The two factors go hand-in-hand, because more than 80% of the processing trade is undertaken by FIFs.[9] In the next section, using a probit model, we

[7] Such a weak exporter's advantage over nonexporters in an agglomerated region may not be a problem specific to China. For instance, Okubo and Tomiura [35] reported that the Japanese exporter's advantage over nonexporters is negligible in large cities such as Tokyo and Osaka.

[8] It is also possible that local protectionism or market fragmentation in China result in high fixed costs associated with domestic supply [28].

[9] The share of FIFs in exports categorized as processing trade was 84% in 2010, whereas indigenous

directly examine the possible effect on exports caused by spillover from agglomeration, taking into account the ownership of Chinese firms.

INSERT Table 2 Here

4.2 Probit model

4.2.1 Basic results

The basic results of the estimation explained in section 3.3 are displayed in Table 3. All specifications include year dummy variables, 3-digit industry dummy variables, and province-level region dummy variables. Column (1) corresponds to the model incorporating the industrial aspect of agglomeration, while column (2) corresponds to the model incorporating the ownership of the incumbent exporters and the location of the agglomeration. The coefficients on firms' basic characteristics are positive and significant across all specifications, except for the one on TFP in column (1). The export status in the previous year has a positive contribution to current export participation, indicating a hysteresis effect. The predicted probability of a firm exporting at present is approximately 58% greater if the firm exported previously. The coefficient on TFP is positive and significant in column (2), which suggests that the theories of self-selection of heterogeneous firms are relevant to the exports by Chinese firms. Moreover, the significant coefficients on firm size and wage payments suggest that scale economy and skill intensity play significant roles in export entry.

Turning to the agglomeration variables, column (1) reports that the agglomeration of incumbent exporters in the same county and industry (agg1_1) and that of exporters in the same county but different industries (agg1_2) have positive and highly significant impact on export participation. Particularly, the marginal effect of the former is larger than that of the latter, indicating

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exporters engaged in 70% of China's ordinary exports [36].

that intra-industry spillover from agglomeration of exporters is more rewarding than inter-industry spillover. This suggests that the essence of this spillover is sector-specific knowledge rather than stronger backward or forward industrial linkages. However, we must note that the marginal effects of agglomeration implied from those coefficients are fairly small. For example, they indicate that a one unit increase in the number of exporters in the same county and industry is associated with a 0.1% point increase in the predicted probability of being an exporter. In column (2), we observe how the export spillover from agglomeration differs according to the ownership and location of incumbent exporters. With regard to agglomeration of indigenous exporters, it is found that the numbers of exporters located in the same county (agg2_1) and those in the same province but different counties (agg2_2) have positive and significant coefficients. The marginal effects indicate that the spillover from the agglomeration of indigenous exporters is larger when agglomeration is located within the same county (agg2_1) than when it is located in different counties (agg2_2). This observation is consistent with Greenaway and Kneller [9], and also with previous evidences that knowledge spillover is considerably localized [10,37].

Conversely, an agglomeration of FIF exporters in the same province but different counties (agg3_2) has a negative sign, while that in the same county (agg3_1) has a positive sign. Furthermore, the negative marginal effect of agg3_2 is larger than the positive marginal effect of agg3_1. One way to interpret these results is that the agglomeration of exporting FIFs is associated with substantial congestion in labor and intermediate goods markets. This negative spillover can offset the benefits of knowledge spillover when the FIF agglomeration is not located within the same county, as knowledge spillover may be limited because of distance. On the other hand, the positive impact of the agglomeration of indigenous exporters suggests that they either generate a larger knowledge spillover or face less negative congestion effects than exporting FIFs.

INSERT Table 3 Here

4.2.2 Robustness check

We examine whether the positive contribution by an agglomeration of exporters is robust enough to withstand differences in ownership, industrial characteristics, and geographical location of export entrants. Table 4 shows the results of the estimation on the sample split between indigenous firms and FIFs. The contribution of agglomeration is, in fact, more complex when the ownership of potential export entrants is considered. For instance, in columns (1) and (2), we observe positive and significant intra-industry spillover effects for both indigenous firms and FIFs. However, inter-industry spillover is only significant when the entrants are FIFs. Columns (3) and (4) indicate that the agglomeration of indigenous exporters, whether located within the same county or not, contribute significantly to the export entry of both indigenous firms and FIFs. However, the agglomeration of FIF exporters within the same county has negative impact on the export entry of indigenous firms. In fact, this type of agglomeration only contributes to the export participation of FIFs. These results are at odd with Swenson [17] and Mayneris and Poncet [18], who reported that the co-location of FIFs facilitated the export entry of indigenous Chinese firms. The results also run counter to the widely held belief that MNEs are a more promising source of knowledge on overseas markets than domestic firms, because of their multi-market presence and global distribution network [12]. On the contrary, the agglomeration of exporting FIFs provides an opportunity for indigenous firms to access world demand by supplying their products to the concentrated area instead of penetrating foreign markets on their own. If such “indirect exports” have indeed flourished in China, the agglomeration of exporting FIFs can be negatively correlated with the export entry of indigenous firms. An alternative interpretation is that the knowledge spillover from exporting FIFs is of limited use to indigenous firms because of the different nature of their export activities. Many FIFs in China engage intensively in processing trade, which is more about serving the global production network of MNEs than selling final products directly to foreign markets. These export activities require only limited knowledge on consumers' preferences of the business condition in foreign markets.

INSERT Table 4 Here

In Table 5, we address the industrial characteristic of export entrants. This time, our sample is split between potential entrants in high-tech industries[10] and those in other industries. Again, a significant difference emerges. Columns (1) and (2) indicate that only the agglomeration of exporters in the same county and industry (agg1_1) contributes to the export entry of firms in high-tech industries. Turning to the location and ownership of incumbent exporters (columns (3) and (4)), while the agglomeration of indigenous exporters rewards entrants from both high-tech and other industries with positive and significant spillover, that of exporting FIFs within the same county (agg3_1) does not contribute significantly to export entry in high-tech industries. While this is surprising considering the advanced technology of FIFs, the co-location of FIFs may be associated with a more severe negative congestion effect in the case of high-tech industries, such as fierce competition over a small pool of skilled engineers.

INSERT Table 5 Here

Our third robustness analysis checks whether our results are sensitive to location, namely in the coastal area or in the inland. For this purpose, our sample is split into firms in coastal areas

[10] We define high-tech industries as per the definition of OECD, as follows: manufacture of medical and pharmaceutical products, manufacture of aircraft and spacecraft, electronic and telecommunications equipment, and manufacture of medical equipment and meters.

and those inland.[11] One may expect that export spillover is more relevant in coastal areas, where there is a larger agglomeration of incumbent exporters, and thus a larger knowledge spillover can be expected. However, the results in Table 6 show that the spillover resulting from the agglomeration of exporters is significant in both areas, and even stronger inland. The coefficients and marginal effects of agglomeration—whether the firms are within the same county or not—are larger for inland firms than those in coastal areas. Moreover, inland firms enjoy a positive and significant spillover from the agglomeration of FIF exporters located in different counties (agg3_2). Therefore, spillover from the agglomeration of exporters plays a larger role in the export entry of inland firms than coastal area firms. Such counter-intuitive results could be because China's export promotion policy has been most actively implemented in coastal areas. These policy measures may have reduced the cost of export entry and the significance of knowledge spillover from incumbent exporters.

INSERT Table 6 Here

Last, we examine how the spillover from agglomeration differs according to the export entrants' characteristics considered in our estimation, namely their previous export status, TFP, firm size, and wage level. Because Probit is a nonlinear model, the marginal effects of spillover from the agglomeration of exporters are dependent on the values of all other explanatory variables. Our results displayed in Tables 3–6 correspond to the case where those values are set to their means. We can now observe the marginal effects when the other explanatory variables are set to their minimum or maximum value, while all other variables remain at their mean values. Since the previous export status is a binary variable, its minimum (maximum) corresponds to the case where the entrant was a nonexporter (exporter) in the previous year. Table 7 summarizes the results for the sample of

[11] We identify firms located in coastal area counties by observing information on their location.

indigenous firms and FIFs. It can be seen that the sign of the marginal effects is consistent with the results in Table 4, both at the minimum and maximum values of each variable. Interestingly, column (1) indicates that the marginal effects of agglomeration spillover for indigenous firms were markedly larger when the firm had previously exported. However, the opposite effect applies when the potential entrant is an FIF (column (5)). Furthermore, in case of indigenous firms, the marginal effects are larger when a firm's TFP, employment size, and wage take their maximum rather than minimum value. However, if the potential entrant is an FIF, the marginal effects to the entry are larger when employment size and wage are at their minimum. Although it is difficult to provide a concrete explanation of such contrasting effects of export spillover on indigenous firms and FIFs, large FIFs might be well informed about trends in world markets through their parent companies, and thus make less use of knowledge spillover. This exercise also suggests that larger, more productive, and more skill-intensive indigenous firms with previous exporting experience are rewarded with larger spillover from the agglomeration of exporters.

INSERT Table 7 Here

5. Concluding remarks

This paper empirically explores the role of industrial and spatial agglomerations in promoting the export entry of Chinese firms, using a large firm-level dataset. If the initial exporting costs are mainly knowledge-intensive expenditures—such as learning about foreign markets—the agglomeration of experienced exporters can generate a knowledge spillover that reduces the fixed costs of export entry. Unlike previous studies on China that focused on the spillover from FIFs, we evaluate the role of agglomeration, in general, using a parametric and a nonparametric approach.

Our nonparametric analysis reveals that the productivity distribution of exporters located in agglomerated regions is first-order stochastically dominated by that of domestic firms located in the region. The parametric analysis, which measures the contribution of the agglomeration of incumbent exporters to the probability of export entry, found that the agglomeration of exporters in the same region and in the same industry has the largest positive impact. These results suggest the importance of geographical and technological proximity in knowledge spillover. The effect of agglomeration is also shaped substantially by the ownership of incumbent exporters and potential export entrants. While the agglomeration of indigenous exporters contributes to the export entry of both indigenous firms and FIFs, that of exporting FIFs has a negative impact on the export entry of indigenous firms. Other firm characteristics such as previous export status, productivity, employment size, and skill intensity also shape the impact of spillover from agglomeration. In case of indigenous firms, larger, more productive, and more skill-intensive firms with previous exporting experience are likely to enjoy larger spillover from the agglomeration of exporters.

As China seeks an economic growth fueled by innovation and domestic consumption, access to foreign markets by a larger number of Chinese firms—especially private enterprises—remains important. This is because it enables Chinese firms to acquire the cash flows and advanced technologies required to develop new products that capture the potential demand of Chinese consumers, and thereby stimulate domestic consumption. Our study indicates that policies that support the agglomeration of indigenous exporters can be effective in promoting internationalization, especially when firms face high costs in order to export. However, as noted in many studies on the spillover from FDI, and also suggested by our study, the absorption of knowledge spillover requires capability. It is desirable that small indigenous firms receive support that enables them to make best use of such knowledge spillover.

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Figure 1. Probability distribution function of TFP in 2007

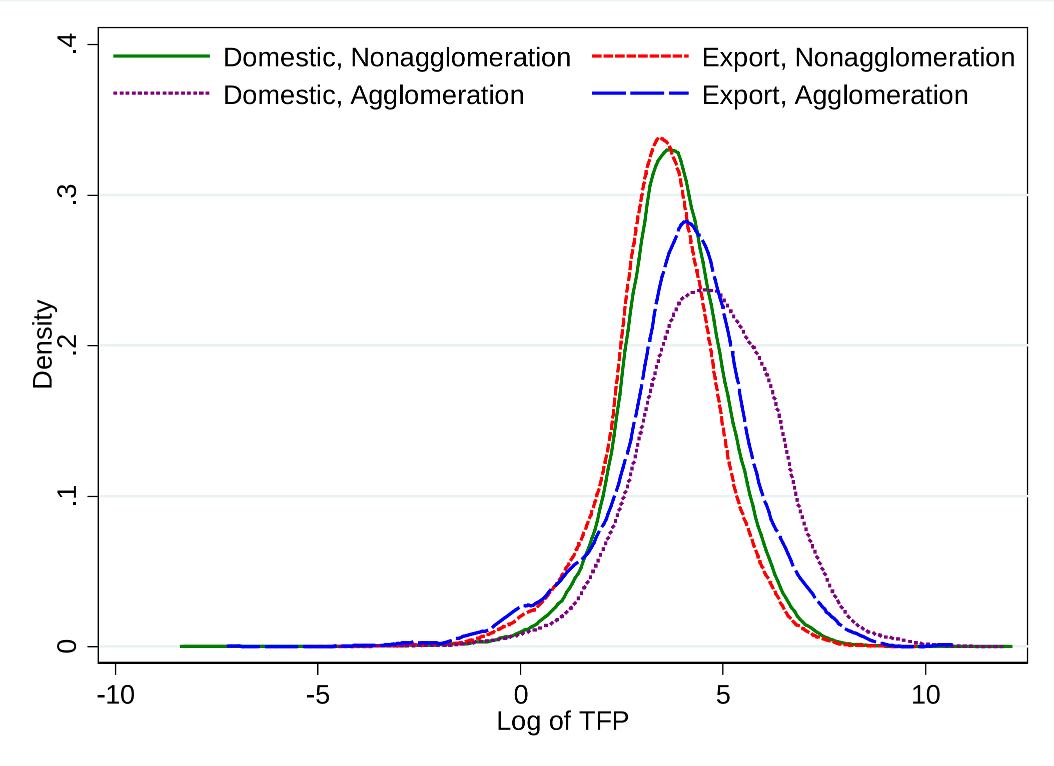

Table 1. Summary statistics

2001 (120052 Obs)					2007 (268304 Obs)				
Variable	Mean	Std. Dev.	Min	Max	Variable	Mean	Std. Dev.	Min	Max
Export status	0.258	0.437	0	1	Export status	0.274	0.446	0	1
TFP	2.833	1.591	-8.055	11.444	TFP	3.637	1.387	-6.466	12.021
lnEmployee	5.131	1.173	0.000	12.019	lnEmployee	4.715	1.098	0.000	11.964
lnWage	6.990	1.401	0	14.632	lnWage	7.268	1.276	-0.019	15.612
agg1_1	3.820	11.485	0	116	agg1_1	10.433	28.250	0	282
agg1_2	91.119	185.427	0	1377	agg1_2	196.813	337.077	0	2134
agg2_1	36.747	56.137	0	313	agg2_1	91.534	146.250	0	744
agg2_2	1673.221	1758.918	13	5847	agg2_2	4057.429	4647.470	11	14406
agg3_1	58.193	160.653	0	1259	agg3_1	115.711	241.178	0	1770
agg3_2	1556.196	1955.788	0	6604	agg3_2	3997.697	4001.559	1	13205

Notes: Table shows only the summary statistics of the regressors at the time of two of 2001 and 2007. The number of full observations used in the estimation of the Probit model is 1,283,110.

Table 2. KS test results

(a). Domestic, Nonagglomearation (A) vs Export, Nonagglomearation (B)

	N. of firms, Share		Statistic, P-value		
year	Group A	Group B	H0: A = B	H0: A > B	H0: A < B
2001	110737	36455	0.026	0.026	-0.002
	(65.6)	(21.6)	[0.000]	[0.000]	[0.800]
2002	116730	40991	0.014	0.014	-0.007
	(65.1)	(22.9)	[0.000]	[0.000]	[0.081]
2003	125958	46469	0.014	0.003	-0.014
	(64.5)	(23.8)	[0.000]	[0.578]	[0.000]
2004	179820	72039	0.042	0	-0.042
	(65.4)	(26.2)	[0.000]	[0.998]	[0.000]
2005	176499	70514	0.03	0	-0.03
	(65.2)	(26.1)	[0.000]	[0.996]	[0.000]
2006	202338	74299	0.038	0	-0.038
	(67.3)	(24.7)	[0.000]	[0.998]	[0.000]
2007	236211	74820	0.075	0	-0.075
	(70.5)	(22.3)	[0.000]	[0.999]	[0.000]

(b). Domestic, Agglomearation (A) vs Export, Agglomearation (B)

year	Group A	Group B	H0: A = B	H0: A > B	H0: A < B
2001	17452	4180	0.037	0.005	-0.037
	(10.3)	(2.5)	[0.000]	[0.825]	[0.000]
2002	17379	4178	0.042	0.013	-0.042
	(9.7)	(2.3)	[0.000]	[0.349]	[0.000]
2003	18397	4340	0.049	0	-0.049
	(9.4)	(2.2)	[0.000]	[1.000]	[0.000]
2004	18283	4729	0.078	0	-0.078
	(6.7)	(1.7)	[0.000]	[1.000]	[0.000]
2005	18534	4987	0.071	0	-0.071
	(6.9)	(1.8)	[0.000]	[1.000]	[0.000]
2006	18973	4863	0.087	0	-0.087
	(6.3)	(1.6)	[0.000]	[1.000]	[0.000]
2007	20085	4147	0.161	0.001	-0.161
	(6.0)	(1.2)	[0.000]	[0.997]	[0.000]

(c). Export, Nonagglomearation (A) vs Export, Agglomearation (B)

	N. of firms, Share		Statistic, P-value		
year	Group A	Group B	H0: A = B	H0: A > B	H0: A < B
2001	36455	4180	0.108	0.108	-0.008
	(21.6)	(2.5)	[0.000]	[0.000]	[0.606]
2002	40991	4178	0.132	0.132	-0.013
	(22.9)	(2.3)	[0.000]	[0.000]	[0.276]
2003	46469	4340	0.142	0.142	-0.011
	(23.8)	(2.2)	[0.000]	[0.000]	[0.384]
2004	72039	4729	0.168	0.168	-0.017
	(26.2)	(1.7)	[0.000]	[0.000]	[0.082]
2005	70514	4987	0.181	0.181	-0.013
	(26.1)	(1.8)	[0.000]	[0.000]	[0.201]
2006	74299	4863	0.188	0.188	-0.011
	(24.7)	(1.6)	[0.000]	[0.000]	[0.345]
2007	74820	4147	0.181	0.181	-0.014
	(22.3)	(1.2)	[0.000]	[0.000]	[0.195]

(d). Domestic, Nonagglomearation (A) vs Domestic, Agglomearation (B)

year	Group A	Group B	H0: A = B	H0: A > B	H0: A < B
2001	110737	17452	0.131	0.131	0
	(65.6)	(10.3)	[0.000]	[0.000]	[1.000]
2002	116730	17379	0.123	0.123	0
	(65.1)	(9.7)	[0.000]	[0.000]	[1.000]
2003	125958	18397	0.145	0.145	0
	(64.5)	(9.4)	[0.000]	[0.000]	[1.000]
2004	179820	18283	0.188	0.188	0
	(65.4)	(6.7)	[0.000]	[0.000]	[1.000]
2005	176499	18534	0.209	0.209	0
	(65.2)	(6.9)	[0.000]	[0.000]	[1.000]
2006	202338	18973	0.229	0.229	0
	(67.3)	(6.3)	[0.000]	[0.000]	[1.000]
2007	236211	20085	0.257	0.257	0
	(70.5)	(6.0)	[0.000]	[0.000]	[1.000]

Notes: The Table shows the K–S test statistics for group A firms versus group B firms, using 2007 data. Asymptotic P-values are shown in brackets. The share of each firm type in all types is shown in parenthesis.

Table 3. Basic results of Probit model on export entry

	[1]full sample		[2]full sample	
	Coef.	M.E	Coef.	M.E
Export status(t-1)	2.3362***	0.5838266	2.3718***	0.5810925
	(624.20)		(623.29)	
lnTFP(t-1)	-0.0007	-0.0001749	0.0043*	0.0010522
	(-0.40)		(2.44)	
lnEmployee(t-1)	0.0128***	0.0032079	0.0124***	0.0030367
	(3.46)		(3.31)	
lnWage(t-1)	0.1844***	0.0460898	0.1919***	0.0470202
	(56.11)		(57.73)	
agg1_1	0.0044***	0.0010897		
	(53.73)			
agg1_2	0.0001***	0.0000199		
	(13.82)			
agg2_1			0.0005***	0.0001195
			(26.06)	
agg2_2			0.0002***	0.0000468
			(112.91)	
agg3_1			0.0000***	9.71E-06
			(5.41)	
agg3_2			-0.0001***	-0.0000272
			(-45.59)	
Industry fixed effects	Yes		Yes	
Region fixed effects	Yes		Yes	
Year fixed effects	Yes		Yes	
Constant	-3.7812***		-3.9452***	
	(-138.66)		(-138.76)	
Pseudo R2	0.6015		0.6088	
Number of obs	1283110		1283110	

Notes: The z-scores are shown in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

Table 4. Results of Probit: comparison between indigenous firms and FIFs

	[1]Indigenous		[2]FIFs		[3]Indigenous		[4]FIFs	
	Coef.	M.E	Coef.	M.E	Coef.	M.E	Coef.	M.E
Export status(t-1)	2.2652***	0.3431437	2.2059***	0.7659834	2.3146***	0.3354668	2.2077***	0.767281
	(493.43)		(308.74)		(493.74)		(308.79)	
lnTFP(t-1)	0.0135***	0.0020387	-0.0247***	-0.0085842	0.0203***	0.0029482	-0.0240***	-0.0083355
	(6.28)		(-7.77)		(9.31)		(-7.52)	
lnEmployee(t-1)	0.1033***	0.0156519	0.0611***	0.0212307	0.0979***	0.0141905	0.0624***	0.0216895
	(21.81)		(9.15)		(20.38)		(9.34)	
lnWage(t-1)	0.1077***	0.0163098	0.0982***	0.0341061	0.1196***	0.017336	0.0992***	0.0344743
	(25.73)		(16.53)		(28.17)		(16.68)	
agg1_1	0.0057***	0.0008668	0.0022***	0.0007635				
	(59.84)		(14.05)					
agg1_2	0.0000	1.04E-06	0.0001***	0.0000244				
	(0.79)		(8.21)					
agg2_1					0.0010***	0.0001421	0.0002***	0.0000673
					(40.84)		(5.49)	
agg2_2					0.0002***	0.0000303	0.0000***	1.64E-05
					(110.02)		(10.16)	
agg3_1					-0.0003***	-0.0000364	0.0001***	0.0000326
					(-18.70)		(8.98)	
agg3_2					-0.0001***	-0.0000212	-0.0000***	-8.51E-06
					(-46.78)		(-5.52)	
Industry fixed effects	Yes		Yes		Yes		Yes	
Region fixed effects	Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes	
Constant	-3.8790***		-2.7041***		-4.0518***		-2.7383***	
	(-125.41)		(-14.40)		(-125.37)		(-14.56)	
Pseudo R2	0.5684		0.5202		0.5804		0.5199	
Number of obs	1014803		268307		1014803		268307	

Notes: The z-scores are shown in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

Table 5. Results of Probit: comparison between high-tech industries and others

	[1]High-tech		[2]Others		[3]High-tech		[4]Others	
	Coef.	M.E	Coef.	M.E	Coef.	M.E	Coef.	M.E
Export status(t-1)	2.4229***	0.8988492	2.3296***	0.5614408	2.4330***	0.9012129	2.3671***	0.5581828
	(167.40)		(600.79)		(166.69)		(600.16)	
lnTFP(t-1)	0.0005	0.0001672	-0.0007	-0.0001773	0.0024	0.0008883	0.0047*	0.0010969
	(0.07)		(-0.41)		(0.40)		(2.53)	
lnEmployee(t-1)	0.0466***	0.0172795	0.0107**	0.0025844	0.0459***	0.0170197	0.0105**	0.0024699
	(3.45)		(2.77)		(3.38)		(2.68)	
lnWage(t-1)	0.1644***	0.0609781	0.1856***	0.0447345	0.1695***	0.0627973	0.1928***	0.0454698
	(13.95)		(54.12)		(14.32)		(55.56)	
agg1_1	0.0031***	0.0011561	0.0044***	0.0010699				
	(5.92)		(53.86)					
agg1_2	-0.0000	-9.46E-06	0.0001***	0.0000232				
	(-1.09)		(15.91)					
agg2_1					0.0003***	0.0000932	0.0005***	0.0001173
					(3.39)		(25.67)	
agg2_2					0.0001***	0.0000472	0.0002***	0.0000457
					(16.60)		(111.75)	
agg3_1					0.0000	1.91E-06	0.0000***	1.17E-05
					(0.24)		(6.32)	
agg3_2					-0.0001***	-2.24E-05	-0.0001***	-0.0000269
					(-6.81)		(-45.10)	
Industry fixed effects	Yes		Yes		Yes		Yes	
Region fixed effects	Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes	
Constant	-2.9307***		-3.7789***		-3.0058***		-3.9440***	
	(-43.72)		(-134.53)		(-43.76)		(-134.69)	
Pseudo R2	0.6041		0.6000		0.6065		0.6077	
Number of obs	74725		1208385		74725		1208385	

Notes: The z-scores are shown in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

Table 6. Results of Probit: comparison between coastal area and inland area

	[1]Coastal		[2]Inland		[3]Coastal		[4]Inland	
	Coef.	M.E	Coef.	M.E	Coef.	M.E	Coef.	M.E
Export status(t-1)	2.4495***	0.767574	2.0927***	0.1765393	2.4536***	0.7681982	2.2020***	0.1636011
	(572.92)		(228.16)		(574.44)		(229.25)	
lnTFP(t-1)	0.0005	0.0001543	0.0049	0.0004124	0.0021	0.0006473	0.0107**	0.0007937
	(0.24)		(1.33)		(1.02)		(2.78)	
lnEmployee(t-1)	0.0149***	0.0046651	0.0868***	0.0073267	0.0159***	0.0049916	0.0705***	0.0052364
	(3.46)		(10.71)		(3.71)		(8.33)	
lnWage(t-1)	0.1940***	0.060788	0.1020***	0.0086069	0.1932***	0.0604963	0.1282***	0.0095214
	(50.78)		(14.38)		(50.55)		(17.27)	
agg1_1	0.0030***	0.0009397	0.0159***	0.0013394				
	(34.80)		(42.12)					
agg1_2	0.0001***	0.0000249	0.0128***	0.0010775				
	(13.40)		(84.22)					
agg2_1					0.0002***	0.0000582	0.0096***	0.0007111
					(9.58)		(55.83)	
agg2_2					0.0000*	1.62E-06	0.0002***	0.0000163
					(2.28)		(36.09)	
agg3_1					0.0001***	0.000047	0.0046***	0.0003413
					(19.52)		(4.59)	
agg3_2					-0.0000	-6.79E-07	0.0052***	0.0003898
					(-0.73)		(26.42)	
	Yes		Yes		Yes		Yes	
Region fixed effects	Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes	
Constant	-4.3521***		-4.3870***		-4.3627***		-4.6946***	
	(-60.01)		(-103.88)		(-60.01)		(-100.50)	
Pseudo R2	0.6156		0.5398		0.6146		0.5805	
Number of obs	923522		355620		923522		355620	

Notes: The z-scores are shown in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

Table 7. Marginal effects at different values of explanatory variables

	Indigenous firms				Foreign invested firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
agg1_1 at	Export status	lnTFP	lnEmployee	lnWage	Export status	lnTFP	lnEmployee	lnWage
Min	0.0004435	0.0006682	0.0003868	0.0002232	0.0005962	0.0006084	0.0008576	0.0008528
Max	0.0020583	0.0010133	0.0018571	0.0020516	0.0003635	0.0008318	0.0005674	0.0003885
agg1_2 at								
Min	5.34E-07	8.05E-07	4.66E-07	2.69E-07	0.0000191	0.0000195	0.0000274	0.0000273
Max	2.48E-06	1.22E-06	2.24E-06	2.47E-06	0.0000116	0.0000266	0.0000182	0.0000124
agg2_1 at								
Min	0.0000706	0.000094	0.0000656	0.0000296	0.0000524	0.0000541	0.0000757	0.000075
Max	0.0003512	0.00018	0.0003033	0.0003624	0.0000321	0.0000732	0.0000497	0.000034
agg2_2 at								
Min	0.000015	0.00002	0.000014	6.29E-06	0.0000128	0.0000132	0.0000185	0.0000183
Max	0.0000748	0.0000383	0.0000646	0.0000772	7.82E-06	0.0000178	0.0000121	8.29E-06
agg3_1 at								
Min	-0.0000181	-0.000024	-0.0000168	-7.57E-06	0.0000254	0.0000262	0.0000367	0.0000363
Max	-0.0000899	-0.0000461	-0.0000776	-0.0000927	0.0000155	0.0000355	0.0000241	0.0000165
agg3_2 at								
Min	-0.0000105	-0.000014	-9.76E-06	-4.40E-06	-6.63E-06	-6.84E-06	-9.57E-06	-9.48E-06
Max	-0.0000523	-0.0000268	-0.0000452	-0.000054	-4.06E-06	-9.25E-06	-6.28E-06	-4.30E-06

Notes: The marginal effects are computed when one of explanatory variable equals its minimum or maximum value and all other variables equal to their mean values. Regarding the export status dummy, the maximum indicates the value of one, while the minimum indicates zero.