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Theory and Evidence

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Abstract

The international trade literature confirms that the average productivity of exporters is higher than that of non-exporters, while economic geography studies establish that urban firms tend to be more productive than rural ones. By introducing region-specific transportation costs in a Melitz-type heterogeneous firm trade model, the theory predicts that the minimum threshold productivity level for export is higher but that for survival by serving the local market is lower in the periphery region than in the core. Using Japanese plant-level panel data, we find evidence supporting the theoretical prediction that exporters in the peripheral regions, especially those distant from the core, have large productivity premiums.

Keywords: core–periphery structure; productivity; exporter; transportation costs; plant data

JEL Classifications: F1; R12; L25

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1. Introduction

Exporters are, on average, more productive than non-exporters—this is a stylized fact that has been firmly established in the literature referencing a wide range of data sources since Bernard and Jensen (1995).[1] Various related issues such as the self-selection of productive firms in exports have been empirically examined (e.g., Bernard and Jensen, 1999; Bustos, 2011; De Loecker, 2007; Roberts and Tybout, 1997). The economic geography literature, on the other hand, confirms that the average productivity of firms or plants is higher in core regions than in peripheral areas within the same country (e.g., Rosenthal and Strange, 2004).[2] These two lines of research, however, are yet to be integrated. Using Japanese plant-level longitudinal data, this study examines if the productivity premium of exporters relative to non-exporters differs between the core and periphery regions within a country and accordingly, discusses the theoretical interpretations of plant-level empirical regularities.

A productivity advantage that exporters have over non-exporting domestic firms is the central element of heterogeneous-firm trade (HFT) models pioneered by Melitz (2003). Despite observed differences in transportation costs across countries and regions, most theoretical models concentrate on the relationship between inter-firm productivity variations and the firms' export

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[1] For example, see Wagner (2012) for a survey of studies since 2006.
[2] According to Combes et al. (2012) and Okubo and Tomiura (2012, 2014), core regions differ from peripheral ones not only in the mean productivity level but also in the shapes of productivity distributions.

decision. To consider such cross-regional differences, we introduce transportation costs that vary by region in a Melitz-type HFT model.

Applying a Melitz-type HFT model to the core–periphery structure within a country trading with another, we propose the following two hypotheses. The productivity premium of exporters over non-exporters is larger in the periphery (a region with limited access to the foreign country), because it is more difficult for local firms to export to the foreign market but easier to survive in the local market. This core–periphery gap in exporters' productivity premium widens with an increase in the distance between the periphery and core regions.

This study tests these predictions by examining variations in exporters' productivity premium across regions in Japan. To preview our principal findings, exporters tend to be more productive than non-exporters particularly in the periphery region. That is, exporters in areas more distant from the core (Tokyo or Osaka) have a larger productivity advantage. These findings are consistent with our theoretical prediction and with the fact that most Japanese exports are through ports or airports located at the core. The core–periphery contrast is observed not only in terms of the average productivity level but also in the shape of productivity distribution.

While this study focuses on the core–periphery structure within a country, international comparison is also an important research topic in the case of spatial variations in exporter premiums. The International Study Group on Exports and Productivity (ISGEP, 2008) compares the productivity premium across 14 countries.[3] While they compare countries by constructing proxies for regulatory qualities, the investigation of Japan, which is *not* a federated country, is suitable for the purpose of our study because the central government holds strong authority in imposing regulations common to all its regions.[4] Further, even though we focus on within-country differentials, regions sufficiently vary in terms of market size within Japan. For instance, Tokyo and Osaka as prefectures report larger GDPs than those of many countries in the ISGEP sample (2008).[5]

Bellone et al. (2014), who also conduct a cross-country comparison, report that the productivity premium of exporters over non-exporters differs between Japan and France. While they mainly discuss cross-sectoral variations, the authors interpret their finding as an indication that the cut-off threshold for export entry varies by country. Unlike Bellone et al.'s comparison of Japan with France, this study focuses on regional variations in Japan.

Although productivity is not discussed, several studies analyze the impact of intra-national geography on the international trade of firms located across regions. Anderson and van Wincoop (2004) emphasize that internal geography is a critical element in understanding the trade costs of international transactions. Using French firm-level data, Crozet and Koenig (2010) detect a

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[3] ISGEP's sample comprises developed countries in Europe, thus excluding Japan from their analysis.
[4] Japan has no export-processing special economic zone.
[5] Of the 14 countries in the ISGEP (2008) sample, the GDPs of the following eight are lower than those of Tokyo or Osaka: Belgium, Sweden, Austria, Denmark, Ireland, Slovenia, Columbia, and Chile.

significant negative effect of interior distance on the number of exporters and average export values. Albarran et al. (2011) show that longer domestic travel time reduces the probability of exporting among small- and medium-sized firms in Spain. Martincus and Blyde (2013) identify a causal effect of within-country travel distance on firms' export values in Chile using an earthquake as a natural experiment. These findings suggest that entry thresholds for exports should differ by region within a country.[6] Accordingly, we examine productivity premiums required for plants to export from different regions in Japan with varying distance to the core, where major international ports and airports as well as various trade-facilitating service functions are concentrated.

The remainder of this paper is organized as follows. Section 2 formalizes our theoretical predictions. Section 3 describes our plant-level data. Section 4 reports the productivity premium comparisons across prefectures. Section 5 directly analyzes plant-level regularities. Section 6 concludes.

2. Theoretical predictions

This section proposes a basic theoretical framework. Our model is an extension of Melitz's (2003) HFT model to a three-region framework with varying transportation costs. The model comprises

[6] In addition to the cited works based on firm-level data, Coşar and Demir (2016) and Lafoucade and Paluzie (2011) use region-level data.

three regions in two countries: the core and periphery regions in the home country and foreign region in the foreign country. The core region is characterized by better access to the foreign country, whereas the periphery region has inferior access. To simplify, we suppose that the core region has a port and periphery does not. To trade with the foreign country, firms in the periphery first ship their goods to the core and then export them to the foreign country through the port in the core region. Using this setting, we show that export premium is smaller (larger) in the core (periphery) regions given the core's better access to the foreign country. A key factor in our three-region model is varying trade costs.

2.1. Basic setup

Our model comprises three regions r, core (r = C) and periphery (r = P) regions in the home country and foreign region (r = F) in the foreign country, and two sectors, manufacturing (*M*) and agriculture (*A*). Preferences take the usual form in the Dixit–Stiglitz framework. The tastes of the representative consumer in each region are

$$U = C_M^{\mu} C_A^{1-\mu}, \quad C_M \equiv \left(\int_{i\in\Theta} c_i^{1-1/\sigma} di \right)^{1/(1-1/\sigma)}, \qquad 1 > \mu > 0, \quad \sigma > 1,$$

where μ is the share of expenditure for the *M* good and $\sigma(>1)$ is a parameter that captures the elasticity of substitution between varieties. There is a mass Θ of varieties available for consumption in the M sector, *c(j)*. *A* good is a numeraire without transportation costs.

We focus on the M sector that produces differentiated products under increasing returns with transportation costs. A typical firm's (firm j) cost function is denoted by $TC(x(j)) = w[F(j) + a(j)x(j)]$. We denote j's output by *x(j).* The firm's variable and fixed cost is expressed as *a(j)* and *F(j)*. Labor is a unique production factor that is not mobile across regions. All costs are borne in labor units with wage rate *w*. As in Melitz (2003), the firm in region *r* faces an overhead-type fixed cost F_r for serving the local market *r* and F_{rk}^X for serving another region *k* ($k \neq r$).

In other words, the fixed cost is $F(j) = F_r$ for non-exporters depending on domestic sales, $F(j) = F_{rk}^X + F_r$ for exporters to region *k*, and $F(j) = F_{rk}^X + F_{rl}^X + F_r$ for exporters to regions *k* and *l*. To reduce the complexity, and since we focus on international trade, we assume $F \equiv F_C = F_P = F_F = F_{CP}^X = F_{PC}^X = F_{CF}^X = F_{FC}^X = F_{PF}^X = F_{FP}^X$ for all firms *j*.

Melitz's (2003) model makes a fundamental assumption of identical fixed costs, that is, *F (j)* = *F*, but different variable costs, *a(j)*, across firms *j*. Firms draw *a(j)* from a lottery subject to a probability distribution. More formally, firms incur R&D costs that amount to F_I, irrespective of the firms' location. The outcome of this R&D activity is random, that is, *a(j)* is the realization of a random variable drawn from a cumulative distribution function, *G(a)*. Following Helpman et al. (2004), it is helpful to assume that the *a*s are Pareto distributed, specifically $G(a) = \left[\frac{a}{a_0}\right]^\rho$ $0 \le a \le a_0 = 1$. We note that ρ and a_0 are the shape and scale parameters for the

Pareto distribution. For simplicity, we assume that shape ρ is the same in any region and scale a_0 is normalized to one.

Since firms produce under increasing returns and the products are differentiated, competition is imperfect. Typical of the Dixit–Stiglitz's (1977) framework, profit-maximizing pricing results in producer prices that are independent of the market being served:

$$p(j) = \left(\frac{1}{1-1/\sigma}\right) a(j) w .$$

The above expression includes constant mark-up pricing since $1/(1-1/\sigma)>1$. Serving the export market entails iceberg transportation costs. More specifically, for one unit of good $x(j)$ to reach the export market, $tx(j)$ units must be shipped with $t > 1$. As a result of Dixit–Stiglitz monopolistic competition, consumer prices are $p(j)$ and $tp(j)$ in the domestic and export markets. Owing to the numeraire sector without trade costs, A sector, wages can be normalized in both countries ($w = w^* = 1$). In this framework, the operating profits of a typical home firm in the domestic and export markets are

$$\pi_r(j) = a(j)^{1-\sigma} \frac{\mu E_r}{\sigma \Delta_r} \quad \text{and} \quad \pi_{rk}(j) = a(j)^{1-\sigma} t^{1-\sigma} \frac{\mu E_k}{\sigma \Delta_k} , \tag{1}$$

where E_r is aggregate expenditure and Δ is the price index raised to the power $1 - \sigma$ and divided by $\left(\frac{1}{1-1/\sigma}\right)^{1-\sigma}$. Δ captures the strength of the market-crowding (or local competition) effect and typically, market crowding is increasing in the number of firms operating in the market.

We assume E_r and E_k as exogenously given and accordingly, we solve the problem of a typical firm. From Eq. (1), it is clear that operating profits are decreasing in *a(j)*. In addition, firms serve the domestic market if and only if $\pi_r \geq F_r$. Conversely, firms export if and only if $\pi_{rk} \geq F_{rk} = F$. Then, firms do not produce if $\pi_r < F_r = F$. Therefore, if *a(j)* is too high, firm *j* will not serve the domestic market and/or not export. Thus, we define the cutoff levels for D-type firms and X-type firms, a_r^D and a_{rk}^X, as the variable costs for the least efficient non-exporter and exporter (to region *k*) in region *r*. These variables and their foreign counterparts are described by the following system of equations: $\pi_D(a_r^D) = F$, $\pi_X(a_{rk}^X) = F$. We can rewrite them as $\pi_X(a_{rk}^X) = t_{rk}^{1-\sigma} \frac{\mu E_k}{\sigma \Delta_k} \left(a_{rk}^X\right)^{1-\sigma} = F$ and $\pi_D(a_r^D) = \frac{\mu E_r}{\sigma \Delta_r} \left(a_r^D\right)^{1-\sigma} = F$.

From these two conditions, we can derive

$$a_{rk}^X = \frac{1}{t_{rk}} a_k^D , \qquad (2)$$

which is called the cut-off condition. Next, we need an expression for the entry process.

We consider an entry process similar to that in Melitz (2003) and Okubo(2009). Suppose R&D costs are the same in both countries such that potential firms pay F_r^I as long as there are profit opportunities. This means that R&D activities are international and the costs related to R&D activities such as patent fee and loyalty and property rights are internationally harmonized as F_r^I . We denote realized pure profits by π . Assuming that there is no discounting and that capital markets are perfect, we obtain $E[\pi] = F^I$, that is,

$$\begin{aligned} F_r^I &= \int_0^{a_r^D} (\pi_D(a) - F) dG(a) + \sum_{k \neq r} \int_0^{a_{rk}^X} (\pi_X(a) - F) dG(a) \\ &= (\lambda - 1) F \left\{ \left(a_r^D\right)^\rho + \sum_{k' \neq r} \left(a_{rk'}^X\right)^\rho \right\} \end{aligned} , \qquad (3)$$

where $\lambda \equiv \rho/(1 - \sigma + \rho)$. For simplicity, we assume $F^I = F_r^I$ for all regions. Using free entry, the ratios of two regions, *r* and *k* (or *l*), can be written as

$$\frac{\left(a_C^D\right)^\rho + \left(a_{CP}^X\right)^\rho + \left(a_{CF}^X\right)^\rho}{\left(a_P^D\right)^\rho + \left(a_{PC}^X\right)^\rho + \left(a_{PF}^X\right)^\rho} = 1 \quad \text{and} \quad \frac{\left(a_F^D\right)^\rho + \left(a_{FC}^X\right)^\rho + \left(a_{FP}^X\right)^\rho}{\left(a_C^D\right)^\rho + \left(a_{CF}^X\right)^\rho + \left(a_{CP}^X\right)^\rho} = 1 . \qquad (4)$$

We call this the free-entry ratio condition.[7] Our key interest is to compare export premiums when exporting from the core or periphery region to a foreign country. Our model aims to show how and why export premiums differ between the core and periphery. Export premium in region *r* (to export to foreign region *F*) can be measured by the gap between a_{rF}^X and a_r^D ($r \in (C, P)$). To investigate this phenomenon, we use the above-mentioned two key conditions: the cutoff condition (Eq. (2)) and the free-entry ratio condition (Eq. (4)).

2.2. Core–periphery structure

This subsection characterizes the core–periphery structure in the home country. To highlight the difference between core and periphery, we assume that the core region has superior access to the foreign market because it has better international ports. Since Japan is a small island, the transportation cost between the core and periphery regions is significantly lower than the

7 See Okubo (2009) for more details.

international transportation cost. Moreover, most of the major international ports in Japan, such as Tokyo, Yokohama, Nagoya, Osaka, and Kobe, are concentrated at the core. Many exporters in the periphery region ship their good to these ports in the core, as will be explained in the next subsection. Thus, transportation costs t_{rk} (from region r to k) can be specified as $\overline{T} > T > \tau > 1$, where $\overline{T} \equiv t_{PF} = t_{FP}$, $T \equiv t_{CF} = t_{FC}$ and $\tau \equiv t_{CP} = t_{PC}$. Domestic transportation costs (i.e., transportation costs between the core and periphery) τ are always much lower than international transportation costs T and $\overline{T}$. However, international transportation costs between the core region and the foreign country, T, are lower than those between the periphery and foreign country, $\overline{T}$, because of the international port in the core region. Periphery firms ship their products to the core and then export them via the core ports. To prevent a detour in transportation, the periphery incurs the same transport costs for direct exports as those for indirect exports via the core. Accordingly, transportation costs can be simplified as $\overline{T} = T\tau$. We assume that T is much larger than τ.

Using this setting, the free-entry ratio condition (4) can be re-written as

$$\frac{\left(a_C^D\right)^\rho + \left(a_{CP}^X\right)^\rho + \left(a_{CF}^X\right)^\rho}{\left(a_P^D\right)^\rho + \left(a_{PC}^X\right)^\rho + \left(a_{PF}^X\right)^\rho} = \frac{\left(a_C^D\right)^\rho + \left(\frac{1}{\tau} a_P^D\right)^\rho + \left(\frac{1}{T} a_F^D\right)^\rho}{\left(a_P^D\right)^\rho + \left(\frac{1}{\tau} a_C^D\right)^\rho + \left(\frac{1}{T\tau} a_F^D\right)^\rho} = 1. \qquad (5)$$

From this condition, we can derive $a_C^D < a_P^D$ (see Appendix 1 for the proof). Since the same analogy can be applied to the periphery region and foreign country, $a_P^D < a_F^D$. Thus, we get

$a_c^D < a_p^D < a_F^D$.

Using the cutoff conditions $a_{CF}^X = \frac{1}{T} a_F^D$ and $a_{PF}^X = \frac{1}{T\tau} a_F^D$, we get $a_{CF}^X > a_{PF}^X$. Thus, we can conclude that the export premium in the periphery region is larger than that in the core. Intuitively, since the periphery region has poor access to the foreign country, the periphery's market is protected from competition against firms in other regions, accommodating local firms. This increases the export premium. By contrast, export premium in the core region is lower because of its better access to the foreign country.

Proposition 1: Export premium in the core region is smaller than that in the periphery region.

2.3. Domestic transportation costs

In this subsection, we investigate comparative statics in terms of domestic transportation costs. Applying the implicit function theorem to the free-entry ratio conditions (Eq. (2)), $\frac{da_C^D}{d\tau} > \frac{da_P^D}{d\tau} > 0$ and $\frac{da_{PF}^X}{d\tau} < \frac{da_{CF}^X}{d\tau} < 0$ hold (see Appendix 2).[8] Higher transportation costs between the core and periphery regions (or if the periphery region is geographically distant from the core) increase export premium in both regions. However, export premium in the periphery region expands more than that in the core because an increase in the export premium is larger in

[8] Here, note that a small τ (>1) is required.

the periphery than in the core. Further, in the periphery region, higher domestic transportation costs, including higher foreign transportation costs, protects the periphery's firms from competition against firms in the core and foreign regions. While this accommodates a higher number of entries, it reduces exporters in the periphery region.

Proposition 2: The core–periphery gap in export premiums expands with an increase in the distance between the periphery and core regions (higher domestic transport costs).

3. Data description

This study uses micro-data from Japan's *Census of Manufacturers* (*Kogyo Tokei* in Japanese). The census gathers data annually for all plants with no less than four employees across manufacturing industries and twice in every five years for plants with employees less than the threshold. In addition to the size threshold for annual surveys, data on capital, needed to estimate total factor productivity (TFP), are available for plants with no less than 30 employees. Consequently, we focus on plants with 30 or more employees. Since the extremely small-sized plants seldom export and produce negligible volumes of output, it is unlikely that omitting such plants will affect our conclusions on economic geography.

Since Bernard and Jensen (1995), manufacturing census data have been repeatedly used to analyze exports at the plant level. The main items captured by the Japanese census are the same as those in the U.S. census. The Japanese census contains basic information on plant characteristics such as output (shipment), export, employment (number of regular employees), capital (tangible fixed assets), and material expenditures.[9] Similar to the U.S. manufacturing census, that of Japan defines exports as products for which the manufacturer clears customs under its own name.[10]

Our research is based on longitudinal plant-level data for 2002–2008. Since the Japanese manufacturing census began collecting export data in 2001, our sample period begins from 2002 to incorporate a one-year lag for certain variables. The most recent data available at the time of initiating this research project were for 2008. We estimate TFP for each plant applying Levinsohn and Petrin's (2003) method to longitudinal plant-level data.[11]

Table 1 reports the summary statistics. About 10% of the plants export their products (*EXP*). Section 4 defines the variables. These observations of limited participation in exporting are in line with the stylized facts established since Bernard and Jensen (1995). Wide variations in many variables, including productivity and plant size, across plants suggest the importance of plant-

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[9] Material expenditures are reported in combination with fuel and electricity spending.

[10] As per this definition, exports are limited to direct exports and thus, do not include indirect exports handled by trade intermediaries. This limitation is inevitable in almost all manufacturing census data. Moreover, transaction-level export data from Japan's custom clearance statistics have not been disclosed for research purposes. Since large-sized firms, such as automobile final assemblers, occupy significant shares in Japan's exports given the direct export of their products without help from intermediary firms, our results for direct exports should substantially cover overall exports.

[11] We estimate the Cobb–Douglas production function with capital and labor for each industry and define the residuals as the plant's TFP. We use expenditures on materials as an instrumental variable in estimating TFP. We later discuss the issue of errors in estimating TFP.

level investigations.

4. Comparisons across prefectures

This section estimates variations in exporter productivity premium by region in Japan. We compare the core and periphery regions and relate the spatial variations in productivity premium to distance from the core (i.e., Tokyo and Osaka). Japan's territory is divided into 47 prefectures, each of which roughly corresponds to a NUTS2 region; however, we omit Okinawa from our cross-prefecture analysis because of its remote island location.

We estimate exporters' productivity premium relative to that of non-exporters for each prefecture r (r = 1, 2,…, 46) using the following regression:[12]

$$TFP_{jst} = \alpha_r + \beta_r \cdot EXP_{jst} + \varepsilon_{jst} \,. \tag{6}$$

Plant, sector (industry), and year are indexed by *j, s* and *t*. *EXP* is the dummy for exporters, which takes the value of one for plants exporting their products and zero otherwise. ε is the error term. Equation (6) is estimated for each prefecture by including all plants located in the prefecture.[13]

Our key parameter is the set of prefecture-specific coefficients, βs. These are the exporters' productivity premium by prefecture. We estimate Eq. (6) using pooled OLS as numerous time-invariant factors, including plant-specific management skills for exporting, are absorbed in the

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[12] ISGEP (2008) estimates the same model as that in Eq. (6) for each country in their international comparison.

[13] Table A1 in the Appendix presents the number of plants and exporters in each prefecture for 2008.

plant dummies of the fixed-effects model.[14]

To control for sector-specific time-varying shocks, we estimate the same equation using OLS but with sector-year fixed-effect dummies (μ) as follows:

$$TFP_{jst} = \alpha_r^{FE} + \beta_r^{FE} \cdot EXP_{jst} + \mu_{rst}^{FE} + \varepsilon_{jst}^{FE} \,. \qquad (7)$$

In this case, the variables and parameters are denoted by superscript *FE*.

Our results, both with and without sector-year dummies, confirm the well-established fact that exporters are more productive than non-exporters in every prefecture, but the premium is far from uniform across prefectures.[15]

To further check the robustness of our estimates, we consider the errors in estimating TFP. In our regressions, TFP is the dependent variable but is itself an estimate from a production function. Therefore, when discussing the statistical significance on the basis of standard errors in the prefecture regressions, we must consider this type of error. To address this issue, we apply the bootstrap method before estimating TFP. In particular, we note that it is necessary to draw firms (the whole time series for each firm over years) as a unit, not separately draw firms in different years, in the bootstrap procedure.[16] Figure 1 presents the results from the block bootstrap with replacements. Exporters' productivity premium is significantly positive in all prefectures except

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[14] Previous studies including ISGEP (2008) also confirm much smaller point estimates using fixed effects than pooled OLS.
[15] Table A2 in the Appendix reports exporters' productivity advantages for all 46 prefectures.
[16] The results shown in Figure 1 are from 500 iterations for each TFP estimation. The program for the bootstrap calculation can be made available upon request.

Okinawa. Thus, we confirm that our previously shown OLS estimates are not noticeably affected by errors in estimating TFP.

As a preliminary step toward our geographical analysis, we examine the extent of variations in the productivity premium according to the distance from the economic core, Tokyo and Osaka. Many large-sized firms locate their headquarters in the political center Tokyo partly because they are attracted to the agglomeration of government agencies in the nation's capital. In 2008, Tokyo accounted for 18% of the GDP among 47 prefectures, whereas this value amounted to 8% for Osaka. Osaka is the center of West Japan due to its legacy as the national commercial center, although recently, the Japanese economy has become more mono-centric in Tokyo possibly because of the falling costs of international and inter-regional trade and communications.[17]

In terms of foreign market access, if we account for directly neighboring prefectures, more than half of Japan's total exports in 2008 were through seven ports or airports located in Tokyo and Osaka. Further, if we include Aichi Prefecture, the largest manufacturing center and the third largest prefecture in terms of population, more than 70% exports were handled by 10 ports or airports in Tokyo, Osaka, Aichi or directly adjacent prefectures according to the custom clearance statistics by Ministry of Finance. This concentration of major ports and airports in Japan's core region justifies the assumption of different transportation costs between the core and periphery

[17] Kanagawa recently surpassed Osaka in the population ranking, although Kanagawa is directly adjacent to Tokyo.

regions in our theoretical model.

Figure 2 plots the prefecture-level exporter premiums against distance from the core. We measure the great-circle minimum distance from Tokyo or Osaka to the capital city for each prefecture. We present two graphs to report the results of the alternative estimation methods (pooled OLS without dummies and with sector-year fixed effects). As shown by the fitted line in each graph, exporter premium tends to rise with distance from the core. In addition, the premiums are tightly clustered and rather low for prefectures near the core. We confirm these observations irrespective of the methods employed to estimate productivity premium. This cross-regional result is also consistent with ISGEP's (2008) international comparisons of relationships with distance.

5. Plant-level Results

5.1. Productivity premium by pooling plants in all regions

While the comparison of prefecture-level premium reported in the previous section follows the approach taken in ISGEP's (2008) international comparison, this section directly estimates premiums at the plant level. Researchers conducting international comparisons, such as ISGEP (2008) and Bellone et al. (2014), are not allowed to pool firms from different countries into a single regression because of the confidentiality requirements imposed by each country's government. Thus, they do not directly compare firms across countries but compare countries by aggregate summary measures such as exporter premium or productivity index calculated at the country level.

Since this study compares plants within a single country, we can directly estimate the following regression by pooling all plants located in any region in Japan.

$$TFP_j = \gamma_0 + \gamma_1 EXP_j + \gamma_2 Dist_j EXP_j + \gamma_3 Dist_j + \gamma_4 Sec + u_j. \qquad (8)$$

Unlike previous prefecture-by-prefecture estimations, we include the distance from the core (Tokyo or Osaka), denoted by *Dist*. We also add the interactive term between the exporter dummy and distance, *DistEXP*, to capture possible spatial variations in the productivity premium of exporters relative to non-exporters. The error term is denoted by *u*.

Table 2 presents the estimation results for Eq. (8) by covering all plants *j* in Japan.[18] Variables included in the regressions but omitted from Table 2 are sector dummies (Sec). The exporter dummy without interaction, *EXP*, shows that exporters are, on average, more productive than non-exporters. The distance without interaction, *Dist*, confirms that productivity declines with an increase in the plant's distance from the core. While these are confirmations of stylized facts, the significantly positive interactive term *DistEXP* in column (3) demonstrates that exporters are particularly productive over non-exporters when they are located far from the core. All plant-level results are in line with our aggregated prefecture-level comparisons.

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[18] We include all plants located in Japan, except Okinawa, as of 2006.

As an additional exercise, the last column in Table 2 introduces the dummy for the core regions, *Core*, instead of the minimum distance from the core:[19]

$$TFP_j = \delta_0 + \delta_1 EXP_j + \delta_2 Core_j EXP_j + \delta_3 Core_j + \delta_4 Sec + v_j. \qquad (9)$$

As in Eq. (8), we add the interactive term with the exporter dummy, *EXP*. *v* is the error term. The baseline category for comparison is non-exporters in the periphery region. This alternative specification clarifies the core–periphery contrast, instead of continuous change as per distance from the core, in exporters' productivity premium. This additional regression result shows that the productivity advantage of exporters over non-exporters in the periphery region (0.669) is substantially larger that in the core region (0.503 = 0.643 − 0.140), as clearly predicted by the theory. We revisit this core–periphery gap in the following subsection by inspecting productivity distributions.

5.2. Distributional comparisons

Thus far, we have examined premiums in terms of averages but exploring distributional information will enrich our investigations.[20] Figure 3 displays the Kernel-smoothed density graphs for the TFP distributions of exporters and non-exporters for representative prefectures.

The contrast is notable between the core and periphery regions. In the core (Tokyo and

[19] Here, we define the core region by combining the Tokyo and Osaka prefectures.
[20] For example, Combes et al. (2012) and Okubo and Tomiura (2012 and 2014) examine distributional information not captured by averages.

Osaka), the productivity distribution of exporters largely overlaps that of non-exporters, although the former appears slightly to the right of the latter. The heavy overlap of distributions between exporters and non-exporters is also observed at the more detailed city level in Tokyo and Osaka. The central area in Tokyo Prefecture comprises 23 wards (special districts) that, formally, are not a city per se; however, this paper treats these 23 wards as one "city." In contrast, the gap between distributions is sharp in the peripheral prefectures (i.e., see Miyazaki, Kochi, Aomori, and Nagasaki in the figure).[21] This visual impression is consistent with our previous results for the premiums based on averages. The main result reported above remains intact even from frequency histograms before Kernel-smoothing.[22]

Instead of selecting representative prefectures, Figure 4 presents four kernel density curves for the core and periphery regions in a single graph.[23] In the core region, exporters' productivity distributions largely overlap that of non-exporters, although exporters appear to be relatively densely distributed over high-productivity ranges.[24] By contrast, in the periphery region, the productivity distribution of exporters is clearly located to the right of that of non-exporters. While

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[21] These four prefectures are typical peripheral regions, that is, they are located far from the core and rank rather low in regional income.

[22] Figure A1 in the Appendix presents examples of frequency histograms.

[23] To render contrasts visually clear, in this graph, we define Tokyo and Osaka cities as the core and prefectures more than 300 km away from Tokyo or Osaka as the periphery. Graphs with alternative core–periphery definitions are qualitatively similar and can be made available upon request.

[24] Note that within-region variance is not necessarily lower in the core. For example, the standard deviation of plant productivities in Tokyo is ranked at 27^{th}, which is almost at the middle of 46 prefectures. On the other hand, Kochi, shown in Figure 3 as an example of a periphery prefecture, is among the three regions with the lowest variance. Okubo and Tomiura (2014) detect the core–periphery difference in skewness, not variance, by applying gamma distribution to Japanese manufacturing plants.

the proportion of low-productivity non-exporters is notably higher in the periphery than in the core, being located in the periphery leads to a clear rightward shift in exporters' productivity distribution. These distributional findings are consistent with our theoretical predictions.[25]

5.3. Plant-level exporting decisions

This subsection reports plant-level regressions to investigate the impact of productivity on exporting. Plant-level analyses are critical in controlling for plant heterogeneity. In addition, studying plant-level export decisions is important because productivity comparisons might be complicated by the plants' past export experiences. Thus, we need to control for this effect when comparing exporter premium. We do so by conducting a dynamic panel probit estimation of the following equation with lagged dependent variables:

$$\mathrm{P}\left(EXP_{jt} = 1\right) = \Phi\left(\theta_0 + \theta_1 TFP_{j,t-1} + \theta_2 EXP_{j,t-1} + \theta_3 EXP_{j,t-2} + \eta_j\right). \qquad (10)$$

The plant and year are indexed by j and t. EXP_t is the binary exporter status dummy that takes the value of one when the plant exports in year t. Φ denotes the standard normal cumulative distribution function. η is the plant-specific random effect. Table 3 reports the estimation results. We also include sector dummies but omit them from the table. The same specification as that

[25] The core–periphery contrast, particularly among non-exporters (Figure 4), is similar to Okubo and Tomiura's (2014) findings for Japanese plants. Their labor productivity analysis covers virtually all plants, irrespective of their export status, whereas this study focuses on plants above the threshold size to estimate TFP.

shown above is estimated at the plant level separately for the core and periphery regions because the productivity premium differs by region.

Notably, as shown in Table 3, while TFP is significantly positive in the periphery regions (defined in various ways), TFP is insignificant in the central part of Tokyo (Tokyo City). Exporters tend to be significantly more productive than non-exporters in any region except Tokyo City. This finding that productivity in the previous year has a statistically significant effect on exports in the next year in regions outside of the core is in line with our previous result that exporters in regions distant from the core have larger premiums.[26] The table also reveals the persistent effect of past export experience, as is confirmed in previous studies (e.g., Robert and Tybout, 1997).

In the lower panel of Table 3, instead of arbitrarily dividing each plant's location into core and periphery, we include the interaction of distance from the core with the plant's productivity. The significantly positive coefficient on the interactive term indicates that the effect of TFP on exporting decision tends to be stronger for plants located at a greater distance from the core. This finding is clearly consistent with the upper panel of the same table based on the core–periphery dichotomy. The significantly negative coefficient on the distance without interaction implies that plants located farther from the core, contingent on productivity and past export experience, are

[26] Berman and Héricourt (2010) also report the disconnect between exports and productivity. They find that the export–productivity link attenuates as a firm's cash flow/asset or asset/debt ratio deteriorates; however, they discuss international variations in the context of financial development.

less likely to export, which possibly reflects higher transportation costs in the peripheral regions.

To check the robustness of the above result, we investigate the multiple-plant operations of firms. Since the export decisions of other plants operated by the same firm are likely to affect whether the plant exports its product, the impact of productivity on export should be diluted in firms with multiple plants. Our plant-level dataset derived from the *Census of Manufactures* identifies whether each plant is a single plant or one of multiple plants of a firm. Consequently, we also estimate Eq. (10) separately for single and multiple plants and confirm the robustness of our previous finding.[27]

5.4. Propensity-score matching of plants

We employ the matching technique to select a pair of comparable plants from our sample. The matching is important since exporters and non-exporters may differ in characteristics other than productivity.[28]

Table 4 presents the average effect of the treatment on the treated group (ATT; in this case, exporters) in the logarithm TFP within each region. We select comparable plants on the basis of propensity scores and compare the average productivity of exporters relative to non-exporters

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[27] Since the survey contains no data on the firm (corporate headquarters) or other plants under the same ownership, we cannot aggregate our plant data at the firm level or link the data of multiple plants operated by the same firm. Okubo and Tomiura (2016) studies multiple plants and headquarter separation in Japan. The separate estimation results for a single plant and multiple plants can be made available upon request.

[28] While we have assumed the selection of firms based on unobserved variables, this subsection reports the results with selection on observables for the purpose of a robustness check.

within this limited sample for each region (with various definitions for core or periphery). In the alternative first-stage probit regression, reported in the right-hand side of Table 4, we add the exogenous regional share of exporters to consider possible spillover effect in the same region.[29] ATT for specifications with and without regional exporter share in this table confirms that the difference between exporters and non-exporters is notably larger or strongly significant in the periphery, irrespective of its definition. The differential increases in locations that are farther away from the core among the variously defined peripheries. Thus, our results are confirmed even after plant matching.

6. Concluding Remarks

This study investigates how productivity differs between exporters and non-exporters across locations in Japan. While previous studies have repeatedly confirmed exporters' productivity premium in international trade research and the core–periphery productivity gap in economic geography research, they do not examine the two productivity differences in an integrated framework. Our estimation results demonstrate that the productivity premium tends to be smaller when the plant is located closer to the core region, which has superior access to foreign markets. This finding suggests that the export decision of plants particularly in the core is not completely

[29] The exporter share in a region is measured within the same two-digit industry at the city-town-village level (the most detailed geographical unit in Japan).

determined by their productivity, as in the simple HFT model, but by domestic transportation costs that vary in access to major ports or airports.

While this study has integrated exporters' productivity premium with the core–periphery productivity gap, some issues remain unresolved and are left for future independent studies. Among them, the direct data for domestic transportation costs are important to improve our estimates but are not captured in the manufacturing census. It will be informative if future studies could link domestic trade cost data with export data.

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Access to plant-level data is arranged by RIETI.

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Appendix 1: Proof of core–periphery gap

From the free entry condition, $\frac{\left(a_C^D\right)^\rho+\left(\frac{1}{\tau}a_P^D\right)^\rho+\left(\frac{1}{T}a_F^D\right)^\rho}{\left(a_P^D\right)^\rho+\left(\frac{1}{\tau}a_C^D\right)^\rho+\left(\frac{1}{T\tau}a_F^D\right)^\rho}=1$ can be derived.

$$\left(a_C^D\right)^\rho+\left(\frac{1}{\tau}a_P^D\right)^\rho+\left(\frac{1}{T}a_F^D\right)^\rho-\left(a_P^D\right)^\rho-\left(\frac{1}{\tau}a_C^D\right)^\rho-\left(\frac{1}{T\tau}a_F^D\right)^\rho=0.$$

$$\left\{\left(a_C^D\right)^\rho-\left(a_P^D\right)^\rho\right\}\left(1-\left(1/\tau\right)^\rho\right)+\left(1-\left(1/\tau\right)^\rho\right)\left(\frac{1}{T}a_F^D\right)^\rho=0.$$

Thus, $a_C^D<a_P^D$ should always hold.

As discussed in the main text, international transportation costs, T, is much higher than domestic transportation costs τ. Under this condition, the same derivation is applied and $a_P^D<a_F^D$ holds.

Appendix 2: Proof of effect of domestic transportation costs

The free-entry ratio condition for the core region and foreign country can be rewritten as

$$G\equiv\left(a_C^D\right)^\rho+\left(\frac{1}{\tau}a_P^D\right)^\rho+\left(\frac{1}{T}a_F^D\right)^\rho-\left(a_F^D\right)^\rho-\left(\frac{1}{T}a_C^D\right)^\rho-\left(\frac{1}{T\tau}a_P^D\right)^\rho=0.$$

$\frac{dG}{da_C^D}=\rho\left(a_C^D\right)^{\rho-1}(1-T^{-\rho})>0$, $\frac{dG}{da_P^D}=\rho\left(a_P^D\right)^{\rho-1}\tau^{-\rho}(1-T^{-\rho})>0$, $\frac{dG}{da_F^D}=(T^{-\rho}-1)\rho\left(a_F^D\right)^{\rho-1}<0$, and

$\frac{dG}{d\tau}=\rho\tau^{-\rho-1}(a_P^D)^\rho(T^{-\rho}-1)<0$.

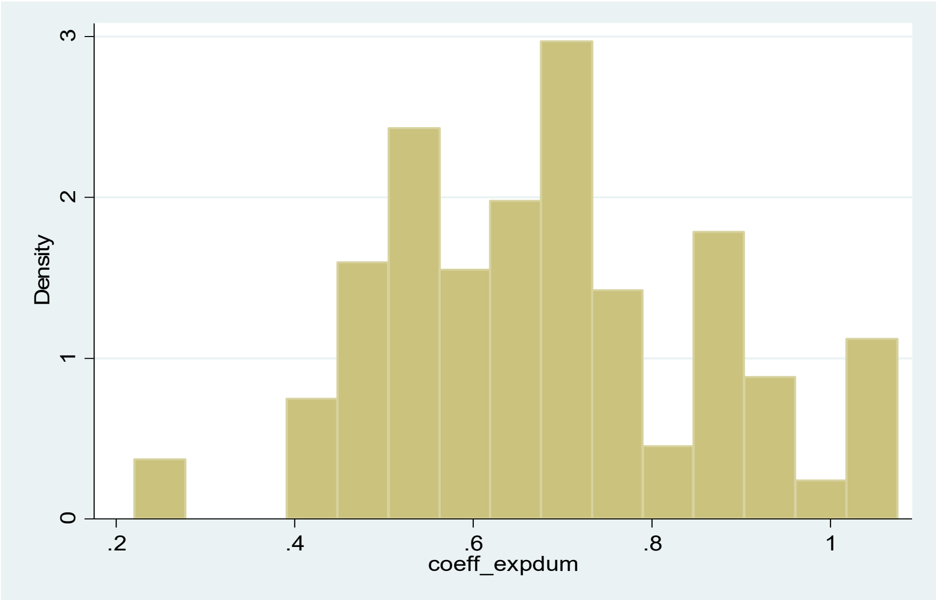
Using the implicit function theorem, we get $\frac{da_C^D}{d\tau}>0$, $\frac{da_P^D}{d\tau}>0$ and $\frac{da_F^D}{d\tau}<0$. Since τ is small (>1), $\left(a_P^D\right)^{\rho-1}\tau^{-\rho}>\left(a_C^D\right)^{\rho-1}$ holds. Therefore, we get $\frac{da_C^D}{d\tau}>\frac{da_P^D}{d\tau}>0$.

Using the cutoff conditions $a_{CF}^X=\frac{1}{T}a_F^D$ and $a_{PF}^X=\frac{1}{T\tau}a_F^D$, we get $\frac{da_{CF}^X}{d\tau}=\frac{1}{T}\frac{da_F^D}{d\tau}<0$ and

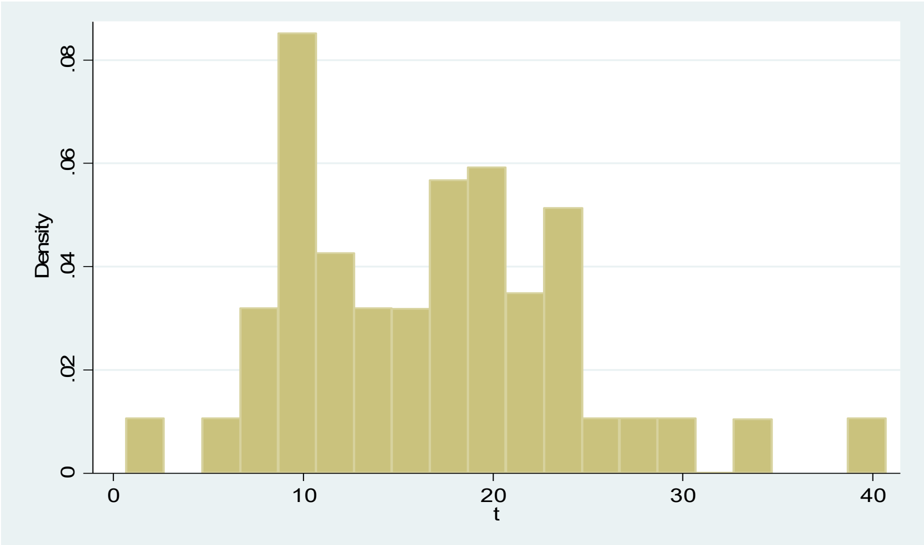
$\frac{da_{PF}^{X}}{d\tau} = \frac{1}{T}\frac{da_{F}^{D}}{d\tau} - \tau^{-2}\frac{1}{T}a_{F}^{D} < 0$. Thus, $\frac{da_{PF}^{X}}{d\tau} < \frac{da_{CF}^{X}}{d\tau} < 0$ holds.

Figure 1: Exporter premium of each prefecture from bootsrap sample

the estimated coefficient on Exporter DUM



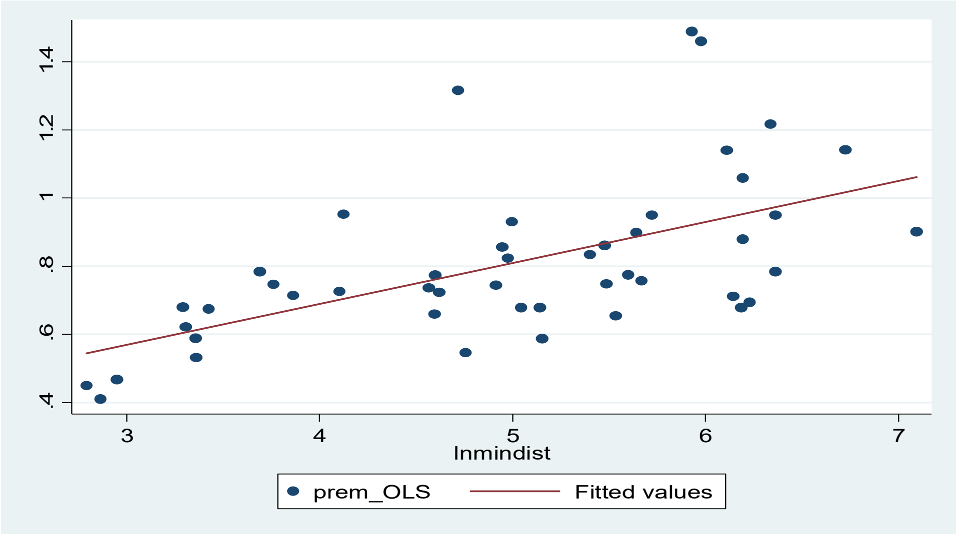
t statistics



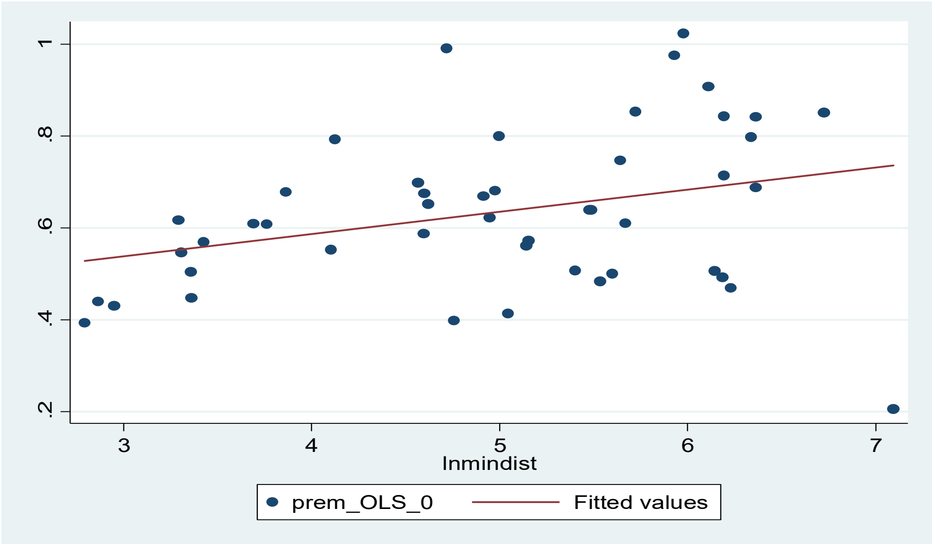
(Notes) The bootstrapped sample number is 500 for each prefecture.
We control for Sector*Year.
The only one prefecture with the insignificant coefficient is Okinawa.

Figure 2: Exporter premium of prefectures and distance from core

OLS, No dummies



OLS with Sec X Year dummies

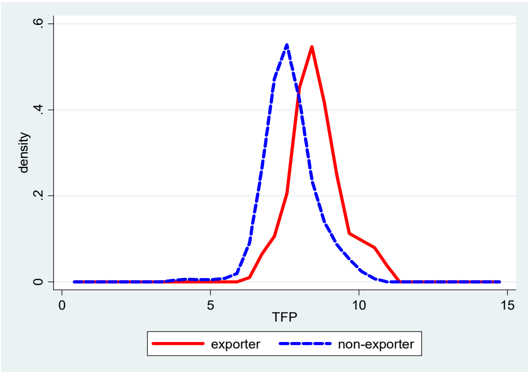


Notes) Estimates of prefectures are reported in Appendix Table A2.

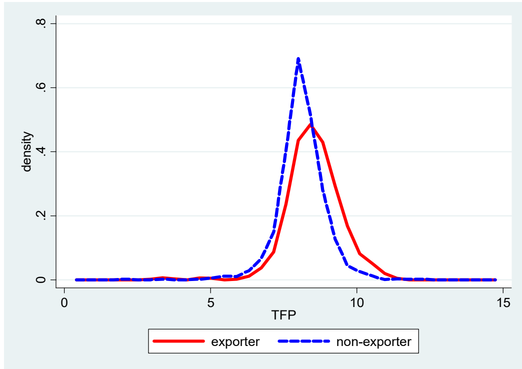
Figure 3: Productivity distributions of exporters and non-exporters

Periphery | ***Core***

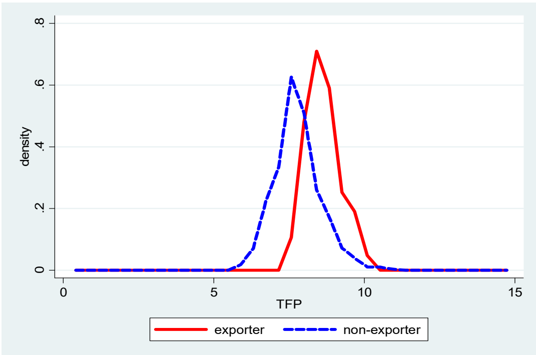
Miyazaki Prefecture



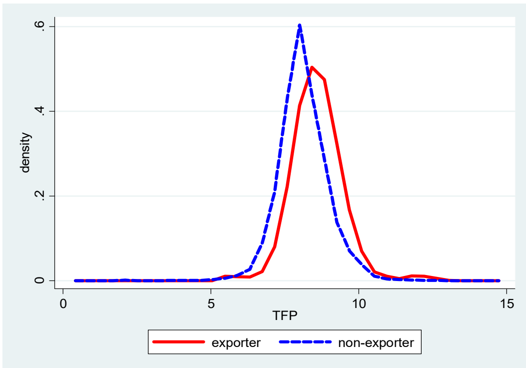
Tokyo Prefecture



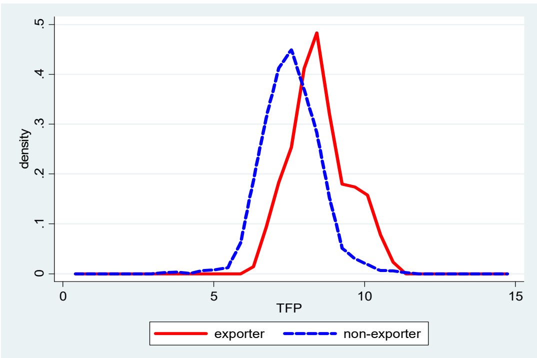
Kochi Prefecture



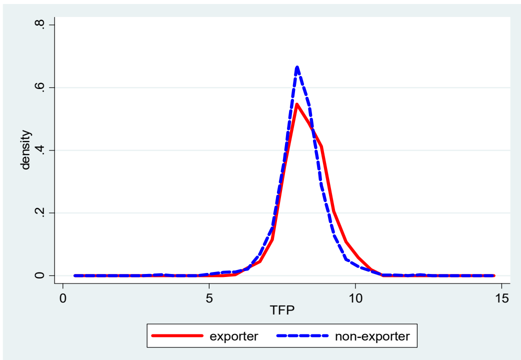
Osaka Prefecture



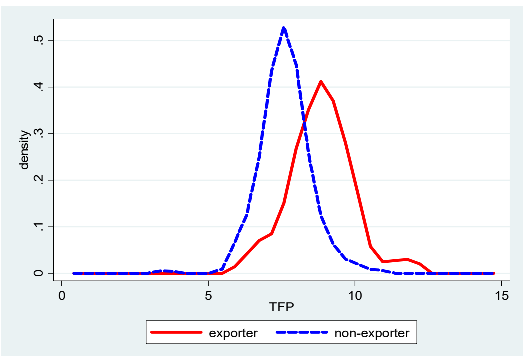
Aomori Prefecture



Tokyo City



Nagasaki Prefecture (Periphery)



Osaka City

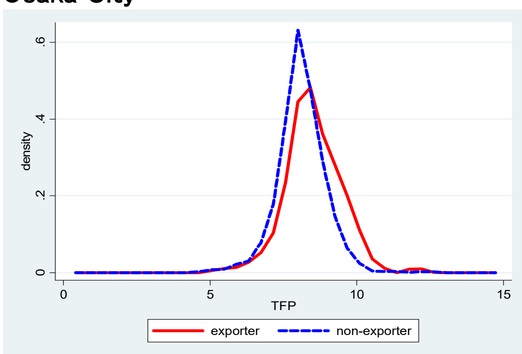
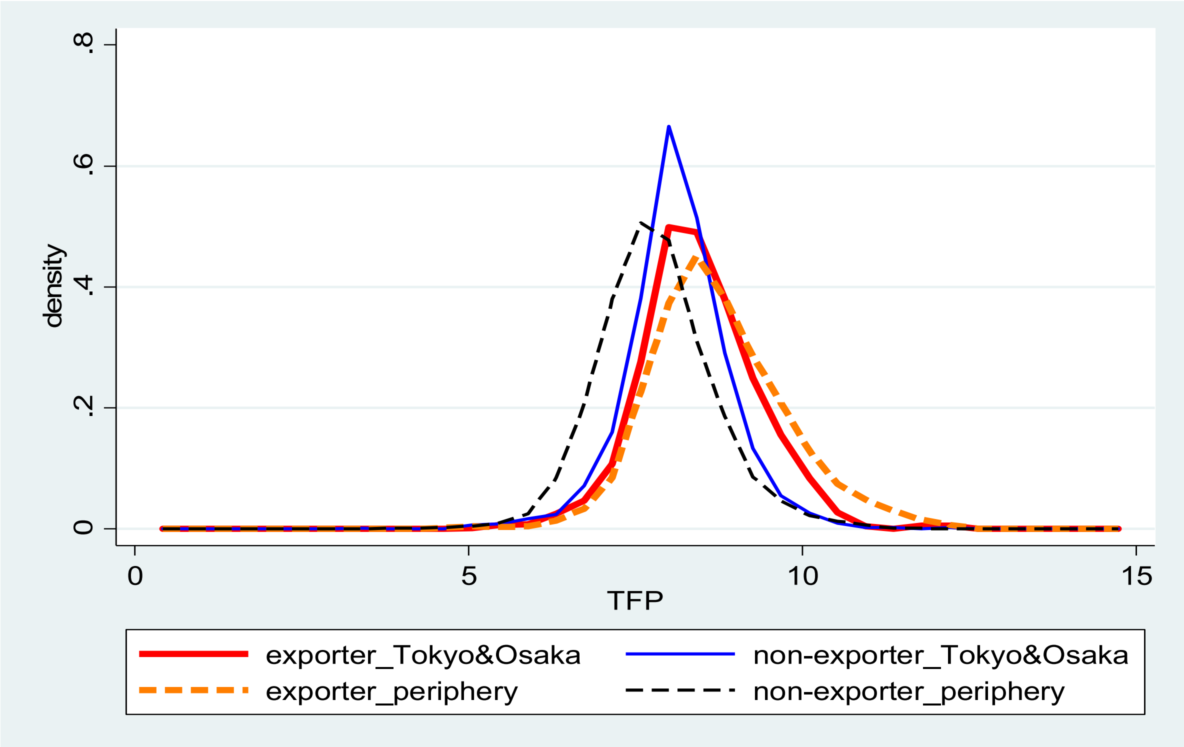


Figure 4: Exporters and non-exporters in core and periphery



Notes) Core is Tokyo City and Osaka City.
Periphery is prefectures distanced from Core by more than 300km.

Table 1: Basic statistics

	Obs	Mean	Std Dev	Min	Max
EXP	325,831	0.099015	0.298682	0	1
TFP	317,139	8.059051	0.899087	−5.83914	14.67323
SIZE	325,831	4.369859	0.79167	0	9.960671
ExpParticipationReg	325,831	0.045844	0.108657	0	1

Table 2: Regressions with interaction terms

Dependent variable: TFP

	1			2			3			4		
	coeff	t-value		coeff	t-value		coeff	t-value		coeff	t-value	
EXP	0.605399	43.06	***	0.593297	42.06	***	0.196042	3.57	***			
EXP_Dist							0.093238	7.48	***			
Dist				-0.07187	-21.61	***	-0.08065	-23.39	***			
EXP_Core										0.643242	30.42	***
Exp_Periphery										0.669245	37.08	***
NonEXP_Core										0.140235	16.27	***
N of plants	44888			44888			44888			44888		
R2	0.1579			0.1665			0.1678			0.1627		

(Notes) These are plant-level estimations. All plants at year 2006 are pooled.
Core is defined as Tokyo and Osaka prefectures. Okinawa prefecture is excluded.
Statistical significance at 1%, 5%, and 10% are expressed by ***, **, and *, respectively.

Table 3: Plant-level regression results on export decision

	Periphery 1			Periphery 2			Periphery 3			Core+Surrounding		
	coeff	z-value		coeff	z-value		coeff	z-value		coeff	z-value	
TFP t-1	0.22432	9.65	***	0.21437	17.66	***	0.1738	10.15	***	0.168	14.6	***
EXP t-1	2.52818	40.08	***	2.45038	77.07	***	2.3599	54.02	***	2.33157	81.12	***
EXP t-2	1.14441	15.9	***	1.04945	31.98	***	1.0886	24.33	***	1.05034	35.61	***
N of obs.	37,005			95,185			35,777			75,775		
N of plants	8,940			22,925			8,602			18,396		
Log-likelihood	−2464.7			−8616.5			−4192			−9452.7		

	Tokyo Prefecture			Osaka Prefecture			Tokyo City			Osaka City		
	coeff	z-value		coeff	z-value		coeff	z-value				
TFP t-1	0.11168	2.79	***	0.16878	5.8	***	0.0648	1.05		0.20287	3.62	***
EXP t-1	2.66781	25.16	***	2.21391	32.65	***	2.6809	18.56	***	2.12662	16.88	***
EXP t-2	1.08438	9.7	***	1.00957	14.66	***	1.0832	7.03	***	1.14428	8.38	***
N of obs.	7,554			12,672			4,603			2,796		
N of plants	1,899			3,214			1,182			811		
Log-likelihood	−760.63			−1715.8			−412.4			−477.85		

Estimations with Regional factors

	coeff	z-value	
TFP t-1	0.0779	2.81	***
TFP*Dist	0.0251	4.08	***
Dist	-0.242	-4.67	***
EXP t-1	2.359	124.6	***
EXP t-2	1.0523	53.89	***
N of obs.	206537		
N of plants	49781		
Log-likelihood	-22480		
Wald Chi-2	54658		

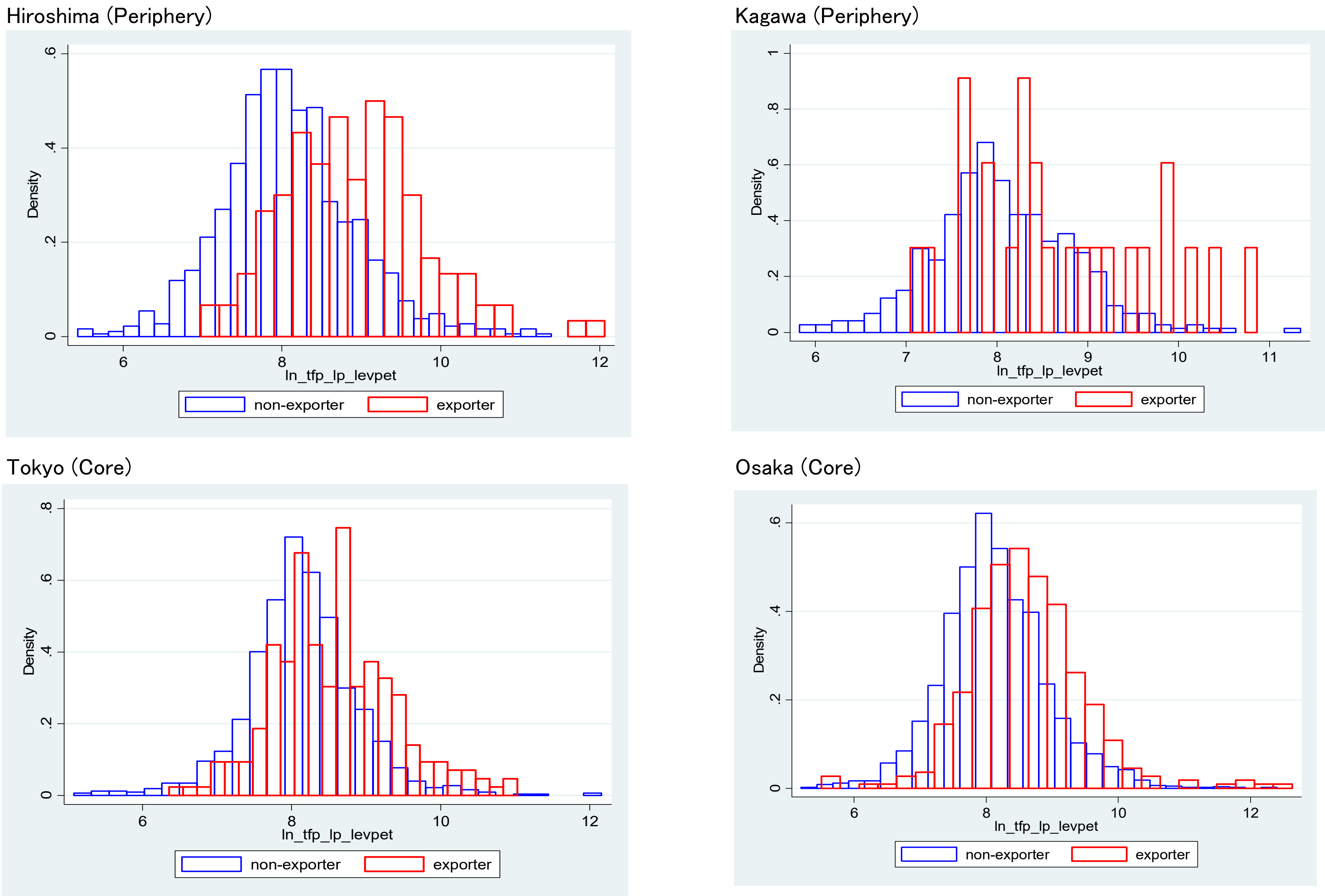
(Notes) Random-effect probit results are shown. Year dummies and sector dummies are omitted.
Statistical significance at 1%, 5%, and 10% are expressed by ***, **, and *, respectively.
Periphery 1 is defined as prefectures located more than 300km far from Tokyo or Osaka.
Periphery 2 is defined as prefectures located more than 100km far from Tokyo or Osaka or Nagoya.
Periphery 3 is defined as prefectures located less than 100km expect Core (Periphery but close to Core)
Core+Surrounding is defined as Tokyo, Saitama, Chiba, Kanagawa, Aichi, Hyogo, Osaka and Kyoto.
Tokyo city is defined as 23 wards in central Tokyo (special districts).

Table 4: Treatment effect of exporting

	ATT			With regional exporter share ATT		
	Difference	t-value		Difference	t-value	
Periphery 1	0.3482812	6.02	***	0.392488	6.38	***
Periphery 2	0.318736	11.27	***	0.316232	11.15	***
Periphery 3	0.3014749	7.49	***	0.308239	7.67	***
Core+Surrounding	0.2117185	7.72	***	0.244673	8.93	***
Tokyo Prefecture	0.2983237	3.11	***	0.194953	2.02	***
Osaka Prefecture	0.1340266	2.12	**	0.228222	3.64	***
Tokyo City	0.2030528	1.84	*	0.255619	2.23	**
All Japan	0.2811262	15.64	***	0.284421	15.86	***

(Notes) ATT is calculated for TFP in logarithm at 2008. Difference is between exporters and non-exporters in each region.
Balance test is passed. Propensity-score matching is with common support and no replacement option.
First-stage logit regressions include size, multi-plant dummy, and sector dummies.
The right column adds ExportParticipationReg into the first-stage logit.

Appendix Figure A1: Frequency histograms



Appendix Table A1: Number of plants

Prefecture				
Code	Name	Num of plants	Num of exporters	Share of Exporters
1	Hokkaido	1,225	31	0.025
2	Aomori	411	21	0.051
3	Iwate	697	38	0.055
4	Miyagi	772	60	0.078
5	Akita	535	33	0.062
6	Yamagata	765	65	0.085
7	Fukushima	1,185	104	0.088
8	Ibaraki	1,537	167	0.109
9	Tochigi	1,143	140	0.122
10	Gunma	1,196	117	0.098
11	Saitama	2,523	331	0.131
12	Chiba	1,323	194	0.147
13	Tokyo	1,643	234	0.142
14	Kanagawa	2,088	374	0.179
15	Niigata	1,313	152	0.116
16	Toyama	782	75	0.096
17	Ishikawa	600	50	0.083
18	Fukui	443	70	0.158
19	Yamanashi	456	75	0.164
20	Nagano	1,291	294	0.228
21	Gifu	1,287	151	0.117
22	Shizuoka	2,422	323	0.133
23	Aichi	3,648	463	0.127
24	Mie	990	146	0.147
25	Shiga	874	144	0.165
26	Kyoto	832	124	0.149
27	Osaka	2,917	391	0.134
28	Hyogo	2,092	314	0.150
29	Nara	375	53	0.141
30	Wakayama	334	36	0.108
31	Tottori	263	27	0.103
32	Shimane	269	25	0.093
33	Okayama	933	118	0.126
34	Hiroshima	1,152	132	0.115
35	Yamaguchi	584	76	0.130
36	Tokushima	255	32	0.125
37	Kagawa	454	25	0.055
38	Ehime	530	54	0.102
39	Kochi	197	16	0.081
40	Fukuoka	1,391	143	0.103
41	Saga	396	37	0.093
42	Nagasaki	324	26	0.080
43	Kumamoto	539	44	0.082
44	Oita	424	27	0.064
45	Miyazaki	408	25	0.061
46	Kagoshima	468	21	0.045
47	Okinawa	169	6	0.036

(Notes) Observation at the year 2008.

Appendix Table A2: Exporter premium of each prefecture

Prefecture		Pooled OLS, No DUM		OLS, Sector X Year DUM	
Code	Name	coefficient	t-value	coefficient	t-value
1	Hokkaido	1.141243	15.252	0.8508957	13.175
2	Aomori	0.94993	9.6562	0.8412704	8.1309
3	Iwate	0.710832	17.316	0.5057693	10.645
4	Miyagi	0.949577	22.849	0.8525301	20.817
5	Akita	1.139748	12.851	0.9067345	9.8782
6	Yamagata	0.756305	17.786	0.6099595	14.034
7	Fukushima	0.860458	24.603	0.638697	17.416
8	Ibaraki	0.773658	22.32	0.6740513	19.559
9	Tochigi	0.658626	19.067	0.5864862	16.858
10	Gunma	0.736392	21.738	0.6984176	21.381
11	Saitama	0.467473	23.509	0.4298056	20.804
12	Chiba	0.784172	22.84	0.6087864	18.513
13	Tokyo	0.409358	12.692	0.4388372	13.479
14	Kanagawa	0.620674	28.124	0.5462021	24.433
15	Niigata	0.654059	22.175	0.4837257	16.232
16	Toyama	0.678346	18.811	0.5610667	15.594
17	Ishikawa	0.678495	16.049	0.4136942	8.0123
18	Fukui	0.545204	11.627	0.3971621	8.7065
19	Yamanashi	0.722255	16.374	0.6520474	14.394
20	Nagano	0.587215	29.553	0.5720388	27.631
21	Gifu	0.531337	20.755	0.4467231	16.665
22	Shizuoka	0.743618	33.62	0.6689304	29.324
23	Aichi	0.680319	37.645	0.6168261	34.094
24	Mie	0.951977	26.694	0.7932191	21.432
25	Shiga	0.713135	20.49	0.6774195	19.047
26	Kyoto	0.746441	19.885	0.6077061	14.685
27	Osaka	0.449333	23.22	0.3926213	20.106
28	Hyogo	0.673844	28.59	0.5688576	23.824
29	Nara	0.58794	12.485	0.5035779	10.114
30	Wakayama	0.725612	8.5661	0.5522068	8.0231
31	Tottori	0.929613	11.9	0.799285	8.742
32	Shimane	0.747748	9.7597	0.6395248	8.1261
33	Okayama	0.823379	23.022	0.6805231	19.583
34	Hiroshima	0.898589	25.058	0.7465112	21.345
35	Yamaguchi	1.488626	31.679	0.9753418	20.273
36	Tokushima	1.315533	17.844	0.9906805	11.737
37	Kagawa	0.855695	10.026	0.6224347	8.3536
38	Ehime	0.774555	11.365	0.5002145	7.8979
39	Kochi	0.833763	9.7931	0.5068068	4.9147
40	Fukuoka	0.677731	19.312	0.4919116	14.344
41	Saga	0.694333	11.203	0.4688406	6.9044
42	Nagasaki	1.216841	16.516	0.7973797	9.0684
43	Kumamoto	0.87949	16.507	0.7139255	12.831
44	Oita	1.460261	13.698	1.0229768	11.247
45	Miyazaki	1.05865	12.08	0.8433778	9.1785
46	Kagoshima	0.784394	7.1704	0.6871565	6.6195