Regional Variations in Productivity Premium of Exporters: Evidence from Japanese Plant-level Data

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Abstract

One well established fact is that exporters tend to be more productive than non-exporters with the standard explanation being selection effects linked to the fixed cost of exporting. This paper exploits a novel dataset to examine the role of fixed-cost selection effects. Japanese plant-level data show the export premium for rural plants but not for urban plants. We document that firms in the urban areas have superior access to wholesale traders who reduce fixed export costs. Thus we find the export premium where export costs are high but none where they are low. This provides support for the selection-fixed-cost nexus which is at the heart of the Melitz model.

Keywords: productivity; exporter; plant-level data; trade intermediation; core-periphery structure

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1. Introduction

Exporters are more productive than non-exporters. This is a stylized fact already firmly established by many previous studies of a wide range of data sources since Bernard and Jensen (1995).[1] The economic geography literature, on the other hand, shows that the average productivity of firms/plants is higher in the core than in the periphery, even within the same country. Based on Japanese plant-level longitudinal data, this paper examines whether the productivity premium of exporters relative to non-exporters varies with distance from the core within a country. We relate regional variations in exporters' premium with access to trade intermediaries, which concentrate in the core regions and facilitate exporting by relatively low productivity firms.

Our results shed novel light on a mechanism that is central to the heterogeneous firms trade models (Melitz 2003, Helpman, Melitz and Yeaple 2004, Bernard, Redding and Schott 2007, Arkolakis 2008, Demidova 2008, Eaton, Kortum and Kramarz 2011). Firms with superior productivity select into exporting resulting in the 'export premium' since the cost of exporting deters less competitive firms. As discussed, for example, by Roberts and Tybout (1997), exporters require "transportation, customs, and shipping services, as well as information on prices, potential buyers, and product standards or requirements in other countries" (p.550). There are, however, ways of economizing on export costs, with trade intermediaries (or wholesalers) being an important way, as Ahn et al. (2011) and Crozet et al. (2013) show. These intermediary firms support logistics for exporting and buyer-seller matching across national borders. As such trade intermediaries tend to locate near urban concentration, the cost of

[1] Wagner (2012) surveys studies since 2006, for example.

exporting is likely to vary across space. Our empirical strategy exploits this spatial variation to test the link between export costs and the export premium.[2] Likewise, transport costs should be lower when the exporter is located near an international port/airport. Knowledge spillovers from other local exporters should contribute to the improvement of the exporter's knowledge on foreign markets. These suggest that firms with relatively low productivity can export if they are located proximate to the core.

This paper compares the productivity premium of exporters relative to non-exporters across prefectures in Japan. To preview our principal findings, the exporter premium tends to be significantly larger in regions distant from the core (Tokyo or Osaka). We confirm that our principal findings on prefecture-level exporter premium are consistent with plant-level export decisions. By combining regional data on wholesalers, this paper further finds that the productivity premium of exporters tends to be smaller in regions where wholesalers are concentrated. This finding is perfectly consistent with the interpretation that trade intermediaries reduce productivity threshold for exporting.

While this paper focuses on cross-regional comparison within a country, international comparison is another important research topic on the spatial variations in the exporter premium. The International Study Group on Exports and Productivity (ISGEP) (2008) compares the productivity premium across 14 countries, including both developed and developing countries.[3] Their study finds that "productivity premia are larger in countries with lower export participation rates, with more restrictive trade policies, lower per capita GDP, less effective

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[2] Also as Amiti and Weinstein (2011) investigate, there are greater risks involved in exporting, which lead exporters to largely depend on trade finance. Firms located closer to financial institutions, which concentrate in urban areas, may have better access to trade finance. Services concentrated in the core and supporting foreign trade include legal consulting and translation services.

[3] The developed countries are all in Europe, while Japan is not included in their analysis.

government and worse regulatory quality, and in countries exporting to relatively more distant markets" (p.596). Our cross-regional comparison complements their cross-country comparison, as we do not need to control for institutional or regulatory variations but still observe substantial economic variations within Japan.[4]

The rest of this paper is organized as follows. Section 2 briefly reviews related studies and explains our motivations for the current research. Section 3 describes our plant-level and regional data, and summarizes descriptive statistics. Section 4 reports empirical results from comparisons of productivity premium across prefectures, and discusses their relations with economic geography. Section 5 analyses plant-level export decisions behind observed productivity premium. Section 6 adds concluding comments.

2. Previous Literature and Our Motivations

This section briefly reviews previous literature on the exporter premium, especially in its relation with geography and trade intermediation. We also explain our motivations for the current research.

2.1. Trade intermediation and productivity premium of exporters

Exporting requires transport, logistics, custom clearance, and matching with buyers across national borders. However, these services are provided by trade intermediaries. Consequently, firms with relatively low productivity can export if they are supported by trade intermediaries. The most important contribution of this paper is the empirical investigation of this relationship

[4] Their cross-country analysis of the impacts of regulatory quality is affected by measurement errors in constructed proxies. Average tariff is not a sufficiently reliable index for trade openness either.

based on plant-level data.

The role of trade intermediation has recently been actively studied in international economics. Theoretical models by Ahn et al. (2011), Akerman (2010), Crozet et al. (2013), and Petropoulou (2010) show that, while high-productivity firms export without intermediation, medium-productivity firms export with trade intermediation since fixed entry costs for exporting are incurred by intermediaries.[5] On empirical side, Ahn et al. (2011) and Crozet et al. (2013) provide related evidence consistent with their theoretical prediction based on transaction-level custom data.[6] Bernard et al. (2013) find that manufacturers on average have higher sales per employee than wholesalers among Italian exporters.[7]

While these findings are valuable for our understanding of trade intermediation, there remain important problems. Previous studies compare wholesalers with manufacturers in terms of their productivity or export-price level, but they are not directly comparable. Furthermore, original manufacturers from which wholesalers purchase exported goods are not identified in their data sets. As a result, the theoretical hypothesis on the relation between productivity and trade intermediation has not been analyzed. Differences in access to trade intermediaries across locations of exporters has not been examined either. This paper compares productivity levels across manufacturing plants in locations different in access to trade intermediaries.

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[5] Mechanisms behind this productivity ordering, however, differ across papers. Ahn et al. (2011) apply the standard Melitz-type heterogeneous-firm trade model, while Crozet et al. (2013) additionally consider costs varying with heterogeneous quality a la Baldwin and Harrigan (2011). Akerman (2010) focuses on economies of scope across multiple goods in wholesalers. Petropoulou (2010) formalizes matching friction between traders.

[6] Akerman (2010) analyzes export destinations/varieties of Swedish firms. Abel-Koch (2013) reports that large-sized firms have a high share of direct exports, though her sample is limited (760 Turkish firms). None of the papers cited above examine productivity in their empirical analyses.

[7] Bernard et al. (2010) report average manufacturers have higher total export values than wholesalers or retailers in the U.S. Productivity is not directly compared in the U.S. case.

By explicitly distinguishing firms types, Bernard et al. (2010) find that wholesalers control merely around ten percent of total export values in the U.S. Bernard et al. (2013) confirm similar figures for Italian firms.[8] Bernard et al. (2010) also report that exports by wholesalers concentrate in agriculture, but this paper focuses on manufacturing, which occupies the overwhelming share in Japan's exports. The direct contribution of wholesalers as exporters is thus limited, but trade facilitation services provided by wholesalers for manufacturers should not be neglected. This paper links plant-level data from manufacturing survey with regional data on wholesalers to discuss regional variations in manufacturers' access to trade intermediations.

2.2. Regional variations in productivity premium of exporters

As we have referred to in the Introduction, ISGEP (2008) is a milestone study on the spatial comparison of the exporter productivity premium. While they compare various countries by constructing proxies for regulatory qualities, we concentrate on the geography effect within Japan. The investigation of Japan, *not* a federated country, is suitable for our purpose, as the central government has a strong authority in imposing nationally common regulation covering all regions.[9] This advantage should be noted, as constructed regulation proxies are inevitably contaminated by measurement errors. Additionally, even though we concentrate on within-country differentials, market size varies sufficiently widely across regions in Japan. For instance, Tokyo or Osaka, as a prefecture, is larger in GDP than many countries in the sample of ISGEP (2008).[10] Consequently, this paper compares regions with virtually uniform regulatory

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[8] The definition of wholesalers varies across previous studies. Bernard et al. (2010) classify U.S. exporting firms into manufacturers and wholesalers, but there are many mixed firms engaged in both manufacturing and wholesaling. To analyze trade intermediation itself, one needs detailed data on internal organization of firms, which are beyond normally available.

[9] In Japan, there is no export-processing special economic zone.

[10] The following eight out of 14 countries sampled in ISGEP (2008) have a lower GDP than Tokyo or

quality but with substantial market size variations.

Waugh (2009) argues that poor countries face higher costs to export compared with rich countries, and finds that these asymmetric trade frictions are quantitatively important in the observed large income differences across countries. While his analysis concentrates on the aggregated country-level, we exploit plant-level data.

Another research line closely related with ours is the analysis of local export spillovers. The empirical evidence on this topic, however, has been mixed. Greenaway and Kneller (2008) and Koenig et al. (2010) find that the number of exporters in the same area has a significantly positive impact on the firm's export decision in the U.K. and France respectively, while Bernard and Jensen (2004) report a surprisingly negative or insignificant relation with the state's share of exporters in the U.S. case.[11] All the previous studies along this line analyzed the impact of other local exporters on the firm's export decision within a given region, but none has examined the exporter productivity premium and its variability with geographic factors, such as the distance from the core.[12]

The focus on the productivity gap between exporters vs. non-exporters clearly differentiates this paper from previous research on local export spillovers. Our cross-regional comparison within a country helps us concentrate on the geography effect by bypassing numerous and often-unobservable differences in the regulatory environment. As the productivity of exporters

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Osaka: Belgium, Sweden, Austria, Denmark, Ireland, Slovenia, Columbia and Chile.

[11] Aitken et al. (1997) find a significant relation only with *multinational* exporters (not exporters in general) in Mexican states. Barrios et al. (2003) find that R&D spillovers have positive effects on firms' exports but detect little evidence on export spillovers in Spain.

[12] As an exceptional analysis of geographical decay, Koenig et al. (2010) find that the spillover effect is almost three times smaller for a firm locating in the same region but in a different area, where France is divided into 22 broadly-defined regions and 341 detailed areas. Rosenthal and Strange (2008) find that the agglomeration effect attenuates with distance in the case of U.S. wages.

is the key component in the new trade theory based on firm heterogeneity, our focus on its regional variations will enrich trade theory by integrating with economic geography.

3. Description of Data and Estimation Strategy

This section explains our micro-data derived from Japan's *Annual Survey of Manufacturers* (Kogyo Tokei in Japanese), and discusses the theoretical rationale for our estimation strategy. This survey covers all the plants with not less than four employees every year across all manufacturing industries. Since the extremely small-sized plants with less than four employees are unlikely to export and produce negligible volumes of output, their omission is unlikely to affect our conclusion on economic geography. We focus on the longitudinal plant-level data from recent surveys available at the time of our research: 2002–2008.[13]

The government's survey contains basic information on plant-characteristics, such as output (shipment), export[14], employment (number of regular employees), capital (tangible fixed assets), and material expenditures.[15] As the survey collects data on capital only for plants with not less than twenty employees, we inevitably omit small-sized plants when estimating Total Factor Productivity (TFP).[16]

The territory of Japan is divided into 47 prefectures, each of which roughly corresponds to a NUTS2 region. In the benchmark case, this paper compares the productivity premium of

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[13] This survey started to collect export data only after 2000.

[14] The destination of export is not identified in the survey, as transaction-level data of custom clearance statistics are not disclosed in Japan. As wholesalers are not covered by manufacturing census such as ours, we will later link regional data on wholesalers.

[15] Material expenditures are reported combined with spending on fuel and electricity. The survey does not record the plant's age.

[16] In a similar study, Koenig et al. (2010) also omit firms with less than 20 employees in France.

exporters vs. non-exporters across prefectures. The summary statistics are reported in Table 1.[17]

The justification for our empirical strategy rests on the central logic of the heterogeneous firm trade (HFT) model. Firms, which are assumed to display heterogeneous productivity and face higher costs to exporting than to selling domestically, select into exporting only when their productivity is sufficiently high. Low productivity firms can only operate and sell on the domestic market (the least productivity firms cannot operate profitably even on the domestic market). The general equilibrium adjustment occurs in the mass of active firms at the precise threshold for the selection. This is called selection mechanism, which results in exporting firm having higher productivity.

Well-known extensions of the HFT model allow for different levels of export costs, typically associating them with wholesale traders that help some firm economize on export costs (Crozet et al 2013, Ahn et al 2011). These extensions show that the basic link between the size of export costs and the size of the exporter premium carry through even when export costs vary across firms. In our data set, we note that access to wholesalers varies across prefectures, so export costs should vary across prefectures. Thus we appeal to a straightforward application of the Crozet et al (2013) and Ahn et al (2011) results to formulate the hypothesis that good access to wholesaler service in urban area should result in lowering export premium.

4. Empirical Results from Prefecture-level Comparisons

This section presents our estimates, based on our firm-level data, of how the exporter productivity premium varies spatially within Japan. We relate this variation to distance from the

[17] The number of plants in each prefecture at 2008 is shown in Appendix Table A1. This table counts only plants of which the data on capital are available. We have confirmed that our main regression results are virtually unaffected even if we weight prefectures by the number of plants. Weighted regression results are available upon request.

core (defined as Tokyo and Osaka), and access to wholesalers.

4.1. Exporter premium

The productivity premium of exporters relative to non-exporters is estimated for each prefecture by the following regression as in ISGEP (2008):

$$TFP_{jt} = \alpha + \beta \cdot EXP_{jt} + \gamma Z_{jt} + \varepsilon_{jt} . \quad (1)$$

The plant is indexed by *j*. *TFP* is Total Factor Productivity estimated for each plant by the method of Olley and Pakes (1996) applied to the longitudinal plant-level data for t = 2002 to 2008. Our use of TFP improves the productivity measurement, as ISGEP (2008) depends on labor productivity due to international data constraints. *EXP* is the dummy for exporters (taking the value "1" for plants exporting their products, zero otherwise). The error term is expressed by ε. Equation (1) is estimated for each prefecture by including all the plants located in the prefecture. Other control variables are summarized by the vector *Z*, which are plant size (employment), its squared term, capital-labor ratio, year dummies, and the two-digit sector dummies.[18]

The set of prefecture-specific coefficients, the βs, are our key parameter. These are the exporter productivity premium by prefecture. Our results are based on the pooled OLS, as numerous time-invariant factors, including plant-specific management skills for exporting, are absorbed in plant dummies of the fixed-effects model.[19] Our results confirm the well-established fact that exporters are more productive than non-exporters, but here we show it holds for every prefecture in Japan, but the premium is far from uniform across prefectures. The productivity

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[18] While size and productivity are assumed to be tightly correlated in Melitz-type trade model, this paper examines TFP premium after controlling for differences in plant size.

[19] Much smaller point estimates by fixed effects compared with pooled OLS are also confirmed by previous studies including ISGEP (2008).

advantages of exporters are reported for all 47 prefectures in Appendix Table A2. We turn now to investigation whether the prefecture-level variation is related with proxies for export costs.

4.2. Relations with distance

The first step is to look at how the productivity premium varies according to distance from the economic core – defining Tokyo and Osaka as the core. Many large-sized firms locate their headquarters in the political center Tokyo, partly attracted by the agglomeration of government agencies in the nation's capital. Tokyo accounted for 18% of GDP and 10% of the population among 47 prefectures of Japan in 2008, while Osaka had 8% of GDP and 7% of the population. Furthermore, more than half of total Japan's exports in 2008 are through seven ports/airports located in Tokyo/Osaka.[20] 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 the political center Tokyo. This is possibly due to the development of transportations and communication systems and due to globalization.[21] We measure the great-circle minimum distance from Tokyo or Osaka to the capital city of each prefecture.

Figure 1 plots the 47 prefecture-level export premiums against distance from the core. We see that the premiums are tightly clustered and quite low for Osaka and Tokyo and closest prefectures (within 40 kilometers).[22] The range of premiums tends to broaden as the distance rises, but there is a clear positive correlation. The productivity premium of exporters tends to be

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[20] Directly neighboring prefectures are included. If we include Aichi prefecture (the largest manufacturing center and the third largest prefecture in population), more than seventy percent of exports are handled by ten ports/airports in Tokyo/Osaka/Aichi or directly adjacent prefectures, according to the custom clearance statistics by Ministry of Finance.

[21] Osaka has recently been slightly surpassed by Kanagawa in the population ranking, but Kanagawa is located directly adjacent to Tokyo.

[22] The figure plots the log of kilometres. The threshold appears around 3.7 and the exp(3.7)=40.45 kilometers.

small in locations proximate to the core. Although they are omitted for the sake of brevity, we confirm similar patterns of the exporter premium also for wage and capital intensity. Exporters are more productive and intensive in physical and human capital than non-exporters when they are located further from the core.

Next, we relate the distance to the prefecture-level concentration of trade intermediaries (wholesalers). We measure it by the transaction values of wholesalers, reported in annual publications of *Current Survey of Commerce* (Shogyo Tokei in Japanese), per square meters for each prefecture. Figure 2 shows that wholesalers are highly concentrated in the core regions. In fact we see a threshold-like behavior with the concentration being relatively insensitive to distance-form-core for prefectures that are more than 40 kilometers outside Osaka and Tokyo. This suggests that trade intermediation services provided by wholesalers are relatively easily accessible if firms/plants are located near the core.

To check the robustness of these prefecture-level comparisons, we also compare more detailed geographic units, namely cities. We focus on the following major cities: (a) capital cities of prefectures, (b) cities with no less than 0.2 million population, and (c) other economic centers.[23] To concentrate on industrial locations, we exclude commuter towns (residential cities located in suburban areas for people commuting to urban centers) even if they have more than 0.2 million residents. The central area of Tokyo prefecture is composed of 23 wards (special districts) that are not formally a city per se, but this paper treats these 23 wards combined as a "city." In total, 91 cities are covered. Figure 3 plots the exporter premium or the regional concentration of wholesalers on the vertical axis, and the distance from the core on the horizontal axis, both at the city level. These graphs confirm our prefecture-level finding; productivity premium tends to be smaller and wholesalers are concentrated in the core even at the city level. It also confirms

[23] The list of cities in the category (c) is available upon request.

the threshold like behavior at distances in the range of 40 kilometers.

4.3. Decomposing premium by regressions

Table 2 statistically confirms the visual impressions in the previous graphs by regressions. The dependent variable is the productivity premium of exporters in each prefecture. The impacts of additional variables are also examined.

The right-hand side variable of the regressions is the distance from the core in the first column.[24] The relation observed in Figure 1 is confirmed statistically significant at any conventional significance level, though we must be cautious in discussing regression results from the limited number in the sample (46 prefectures).[25] This cross-regional result is consistent with international comparisons of the relations with distance by ISGEP (2008).

Another geographic variable we examine is the market potential (Harris, 1954) defined by the weighted average of income levels of regions, with inverse distance as weights as follows:

$$MP_{rt} \equiv \sum_{m=1}^{47} \frac{GDP_{mt}}{D_{rm}} \qquad (2)$$

where D_{rm} is geographical distance between capitals of prefectures *r* and *m*.[26] This index, which varies continuously across all regions, alleviates the possible arbitrariness of our treating Tokyo and Osaka as the core in the previous graph. As market potential is highly correlated with the distance from the core, we include only one of them, not both in the same regression. As

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[24] To check the non-linearity, we have also included squared-term but found it insignificant (omitted from the table).

[25] Out of 47 prefectures, Okinawa is omitted due to its location as remote islands. Although we have also added them in our regressions, squared terms of distance and of market potential turn out to be statistically insignificant.

[26] When $m = r$, the internal distance is calculated by $\frac{2}{3}\sqrt{\frac{Area}{\pi}}$ where "Area" denotes area of the prefecture r (See Combes and Overman, 2004).GDP at prefectural level is taken from the Annual Report on Prefectural Accounts (Cabinet Office of Japan).

reported in the column (2), the productivity premium of exporters tends to be smaller in regions with stronger market potential. This suggests that firms with relatively smaller productivity premium are exporting when they are located near rich large markets.[27]

Third, the columns (3) and (4) of Table 2 investigate the impact of wholesalers in the same region as in Figure 2. Our estimation results show that regional presence of wholesalers is significantly related with smaller productivity premium of exporters relative to non-exporters, even after controlling for the strong effect of distance from the core in the column (4). This suggests that trade intermediations in the region might reduce export entry costs and thus facilitate exporting by plants with relatively low productivity levels, as discussed by Ahn et al. (2011) and Crozet et al. (2013). Our result is at least one of the earliest direct findings on the linkage between trade intermediation and productivity premium of exporters.[28] Although the direct measurement of trade costs is impossible in our limited data, plants located in urban areas are likely to receive benefits from better access to trade intermediation services provided by wholesalers.

Based on these preliminary results, we re-estimate the export premium equation (1) this time by pooling all plants in Japan. Unlike previous prefecture-by-prefecture estimations, we take into account the distance from the core (Tokyo or Osaka). Table 3 reports the results from the regression including the interactive term between the exporter dummy and distance.[29] The

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[27] Though omitted from the table for brevity, we have also confirmed that factor endowment is *not* significantly related with exporters' productivity premium by regressing on prefecture's capital-labor ratio. As cross-regional differentials in factor endowments are naturally narrower within Japan than those between different countries, the insignificant relationship is as expected.

[28] As far as we know, in any of the previous studies (Abel-Koch 2013, Ahn et al. 2011, Bernard et al. 2010, 2013, Crozet et al. 2013), indirect and direct exports are not distinguished. Exports handled by wholesalers are included in their data, but they are not necessarily indirect exports originated in separate manufacturers. The productivity of original manufacturers cannot be analyzed in their data.

[29] Other variables included in the pooled regressions but omitted from Table 3 are plant size, its squared

significant interactive term reported in column (3) indicates that exporters are particularly productive when they are located far from the core, in line with our prefecture-level result.

The last column of this table introduces the interactive term with the dummy for the core-periphery regions.[30] This additional regression result shows that core-periphery productivity gap among exporters (0.2715–0.1648) is roughly comparable with that among non-exporters (0.0926). We will discuss this core-periphery gap again in the next section by inspecting productivity distributions.

4.4. Productivity distributions

While we have examined the premium in terms of averages, the distributional information will enrich our investigations.[31] Figure 4 displays Kernel-smoothed density graphs of TFP distributions of exporters versus non-exporters for representative prefectures.

The contrast is notable between core and periphery. In the core (Tokyo and Osaka), the productivity distribution of exporters largely overlaps with that of non-exporters, although that of exporters appears slightly to the right of that of non-exporters. The heavy overlap of distributions between exporters and non-exporters is also observed at the more detailed city level in Tokyo and Osaka. In contrast, the gap between distributions is sharp in peripheral prefectures (Miyazaki, Kochi, Aomori, and Nagasaki as examples in this figure).[32] This visual impression is consistent with our previous results from the premium based on the averages.

By defining core-periphery at the more detailed city level, Figure 5 presents four kernel density

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term, capital-labor ratio, year dummies and sector dummies.

[30] Here, the core is defined at the city level as Tokyo city (23 wards) and Osaka city combined.

[31] Distributional information not captured by averages is examined by Combes et al. (2012) and Okubo and Tomiura (2012), for example.

[32] These four prefectures are typical peripheral regions in that they are located far from the core and very low in the regional income ranking in Japan.

curves (exporters and non-exporters in core and periphery) in a single graph. This graph confirms our previous finding of agglomeration effect based on the regressions, which detect a significant mean productivity differential between core and periphery both among non-exporters as well as among exporters.

5. Plant-level Results

While the previous section has compared the exporter premium at the aggregated prefecture level, this section examines variations at the individual plant level. The plant-level analyses are critical in controlling for plant heterogeneity.

5.1. Export status decisions at the plant level

The analysis of the plant's export decision is important since productivity comparison might be complicated by plant-level past experiences in exporting. We need to control for this effect in our comparison of the exporter premium. We do this with random-effect panel probit techniques on the following equation:

$$EXP_{jt} = \alpha + \beta \cdot TFP_{j,t-1} + \gamma_0 SIZE_{j,t-1} + \gamma_1 EXP_{j,t-1} + \gamma_2 EXP_{j,t-2} + \delta \cdot W_t + u_{jt} . \qquad (3)$$

The dependent variable *EXP* is the exporter status (the export dummy taking the value one when the plant is exporting). The plant size *SIZE* is measured in terms of employment. Sector dummies are also included. The error term is denoted by *u*. The plant and the year are indexed by *j* and *t*, respectively. The vector *W* in (3) summarizes the following two regional variables: the share of exporters and the concentration of wholesalers, as in Table 2. The exporter share is measured within the same two-digit industry at the city-town-village level (the most detailed geographical unit in Japan), while the concentration of wholesalers is measured at the prefecture level since wholesalers are concentrated in urban cities.[33] The same specification shown above is estimated at the plant level separately for core and periphery, as the productivity premium differs across regions. Table 4 reports the estimation results.

The most notable result in Table 4 is that, while TFP is significantly positive in peripheral regions (defined in various ways), TFP turns out to be insignificant in Tokyo or Osaka, at prefecture or city level. Furthermore, even among the regions outside of Tokyo-Osaka, the estimated coefficient on TFP is largest in the most peripheral regions and relatively low in regions closer or adjacent to Tokyo or Osaka.[34] This finding of a statistically significant effect of productivity in the previous year on the export decision in the next year only in peripheral regions is line with our previous finding of a larger premium of exporters in those regions.

The contrast between the presence of a connection between plant-level productivity and export status in periphery prefectures but its lack in core prefectures provide support for the core element of the HFT model, namely the export-cost-export-premium relationship arising from selection effects.

Another important result in Table 4 is the core-periphery contrast in the effect of trade intermediation. Thickness of wholesaling services in the same region has a significantly positive impact on the plant's exporting decision only in Tokyo, Osaka, and in the regions

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[33] In the regressions of plants within Tokyo or Osaka prefectures, on the other hand, the concentration of wholesalers is measured at the city level. Therefore, the magnitudes of estimated coefficients are not directly comparable between core and periphery.

[34] Prefectures in the "Periphery 1" category are distanced from Tokyo or Osaka by more than 300 kilometers and have no city with more than one million population. Prefectures which have cities with more than one million residents are added to the "Periphery 2" group. "Periphery 3" are prefectures distanced from the three industrial centers (Tokyo, Osaka, or Nagoya city (in Aichi prefecture)) by more than 100 kilometers. "Core+Surrounding" is defined as Aichi, Greater Tokyo (Tokyo, Kanagawa, Saitama, and Chiba), and Greater Osaka (Osaka, Kyoto, and Hyogo).

geographically closer to the core.[35] Combined with our previous findings, this suggests that the exporting-productivity link appears to become attenuated at least partly due to active trade facilitation supports by the concentration of regional wholesalers.

Other findings in the same table are also informative as follows. The persistent effect of past export experience is confirmed as in previous studies (e.g. Robert and Tybout, 1997). The share of exporters in the same industry-region is significantly positive, indicating the local spillover effect from other exporters. This finding of significant spillover effect is consistent with Greenaway and Kneller (2008) and Koenig et al. (2010).[36]

Next, we examine the plant's exit from exporting in order to complement the entry analysis reported above. All the plants exporting in the previous two years consecutively are covered. Similar to equation (3), Table 5 displays the random-effect panel probit results with the exit dummy as the dependent variable. On the right-hand side of the regression, we include plant's TFP as well as plant size, plant's average wage, and the share of exports in plant's own sales (all one-year lagged). Regional share of exporters within the same industry and concentration of wholesalers are also included. Year dummies and sector dummies are added but omitted from the table.

As in the previous table, we detect the significantly negative effect of TFP on exit from exporting only in peripheral regions. As the distance from the core becomes larger, the TFP

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[35] Trade intermediation is especially important for firms with low productivity. According to White Papers on Small and Medium-sized Enterprises by Ministry of Trade, Industry, and Economy, the share of firms engaged in direct exporting is lower than those in indirect exporting among small-sized firms (15.4%<17.5%) in Japan at 2008.

[36] As a paper analyzing the closely related topic from a different angle, Békés and Harasztosi (2013) report that the impact of urbanization (general diversity) on productivity is significant only for traders but that of localization (own industry concentration) is significant both for traders and non-traders in the Hungarian case.

coefficient turns from insignificantly positive to significantly negative. Regional concentration of wholesalers tends to reduce the exit probability in Tokyo, Osaka, and in the regions closer to core, as in the previous table.[37] We also find that smaller plants or plants in regions with fewer exporters are significantly more likely to exit from exporting.

Finally, we discuss issues related to potential endogeneity of variables, especially TFP. As is often the case, it is difficult to find appropriate instrumental variables within our limited plant-level data set. To check the robustness of our results from regressions reported in this section, we estimate the same specifications by employing the generalized method of moments (GMM) with one-period lagged variables as instruments.[38] We have confirmed that our principal findings are largely robust even after controlling for endogeneity by GMM, though the core-periphery contrasts become less evident in the exit regressions.

5.2. Robustness checks

While all plants have been combined in our analyses, this section investigates whether a plant is operated as the single plant or one of multiple plants of the firm, and how this affects our previous findings on the export-productivity relationship. Other robustness check results are also reported in this section.

5.2.1. Single vs. multiple plants

As export decisions of other plants operated by the same firm are likely to affect whether or not

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[37] We have also confirmed that our findings on relation with TFP are robust even after adding other geography variables. Appendix Table A3 reports plant-level regression results with Krugman index of industrial specialization and Entropy index, both in the number of plants at the prefecture level.

[38] We follow Bernard and Jensen (2004) in adopting linear specification in the first difference. GMM estimation results are available upon request.

the plant exports its product, the impact of productivity on exporting should be diluted in firms with multiple plants. Our plant-level data set derived from *Annual Survey of Manufactures* identifies whether each plant is a single plant or one of multiple plants of the firm, though the survey contains no data on the firm (corporate headquarters) or other plants under the same ownership.[39]

Table 6 reports the coefficients on TFP and on wholesaler access in the equation (3) estimated separately for single plants and multiple plants. As expected, the TFP coefficient is estimated larger in the single-plant case than in the case of multiple plants in any periphery. The export choice of plants operated as a part of multi-plant firms appears to be more responsive to the local access to wholesalers compared with single-plant firms, possibly influenced by shipping costs rather than corporate decision on exporting. We also confirm the previous finding even if we control for differences between single plant firms and plants that are part of multiple plant firms; the relationship with TFP is statistically significant only in the periphery, defined in various ways.

5.2.2. Heckman two-step estimation

To handle potential sample selection bias, this sub-section reports results from Heckman two-step estimations. The correction of this bias is important in our case, as productive plants are more likely to export but also more likely to survive. The two-step procedure enables us to examine the effect of productivity on the plant's survival and exporting separately. The plant's survival is the binary dependent variable in our first-stage probit regression, while we regress

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[39] As a result, one cannot aggregate our plant data to the firm level or link data of multiple plants operated by the same firm.

the export share of the plant's sales in the second stage with selectivity correction.[40] Sector dummies and year dummies are included as in previous regressions but omitted from Table 7. All the right-hand side variables are one-year lagged.

Inverse Mill's ratios in Table 7 indicate that non-negligible selection bias is detected in the periphery, where limited plants are exporting, but not in the core. This contrast in the significance of selection bias is consistent with our previous finding of smaller productivity premium of exporters in the core compared with that in the periphery.

The estimation results shown in Table 7 confirm that effects of TFP on exporting are more evident in the periphery compared with the core. Consequently, our main finding of strong productivity-exporting linkage especially in the periphery is robust even after controlling for the selection bias due to plant's survival.

5.2.3. 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 due to various factors unobservable for econometricians.

Table 8 presents the average effect of the treatment on the treated group (exporters in this case), namely ATT, in logarithm TFP within each region. We select comparable plants based on propensity scores and compare the average productivity of exporters relative to non-exporters within this limited sample for each region (with core or periphery defined in various alternative ways). In the first-stage probit regression, exogenous regional variables are included. ATT reported in this table confirms that the difference between exporters and non-exporters is

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[40] Karpaty and Kneller (2011) apply the same two-step procedure for examining export spillovers in Sweden, though the firm's binary export decision is their first-stage dependent variable.

statistically significant only in periphery, however we define the periphery (city or prefecture level). The differential increases in locations more distant from the core among the peripheries variously defined. Thus, our results are confirmed even after plant matching.

6. Concluding Remarks

This paper investigates how productivity differs between exporters and non-exporters across locations within Japan, relating this to geographical variations in proxies for export costs. Our estimation results demonstrate that the productivity premium tends to be significantly larger when the plant is located in a prefecture with good access to wholesale firms. These findings show that the export decision of a plant is not completely determined by the plant's own productivity, as in the simple HFT model. It is also significantly affected by easier access to trade intermediaries. This allows firms located in the core to export despite relatively low productivity.

We interpret this as providing support for a core element of the HFT model, namely the selection effect arising from fixed export costs and the exporter productivity premium arising from the selection into exporting. This support, while contributing to our understanding of the model, must be qualified. The data from the manufacturing survey does not allow us to control for several transport costs that might differ across export destinations.[41] While acknowledging the problem, we note that it impacts on our key result only to the extent that rural and urban manufacturing firms export to systematically different destinations and we have no reason to believe this is the case. Furthermore, corporate financial information, which helps us measure costs of export financing, is not included in the manufacturing survey. It will be informative if

[41] Crozet et al. (2013) find that intermediaries are preferred in exporting to remote, protected, or smaller markets, though no productivity data are used.

future studies are able to disentangle trade in intermediates or indirect exporting through wholesalers. These are examples of important tasks left for future research.

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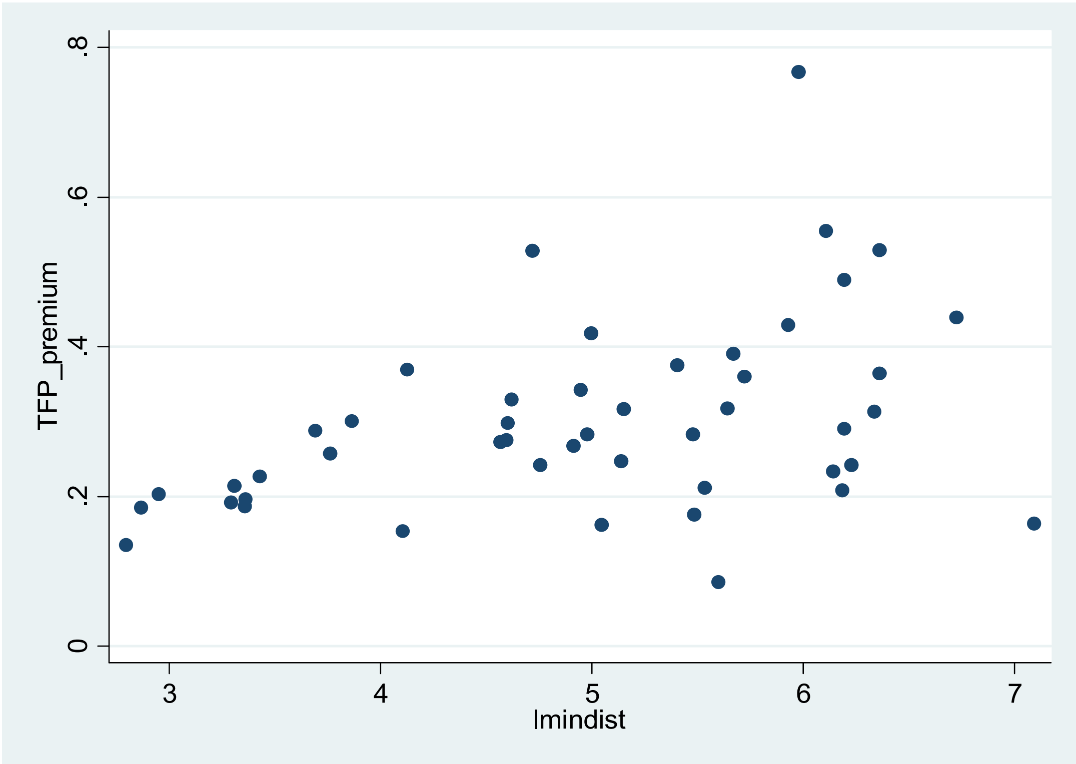
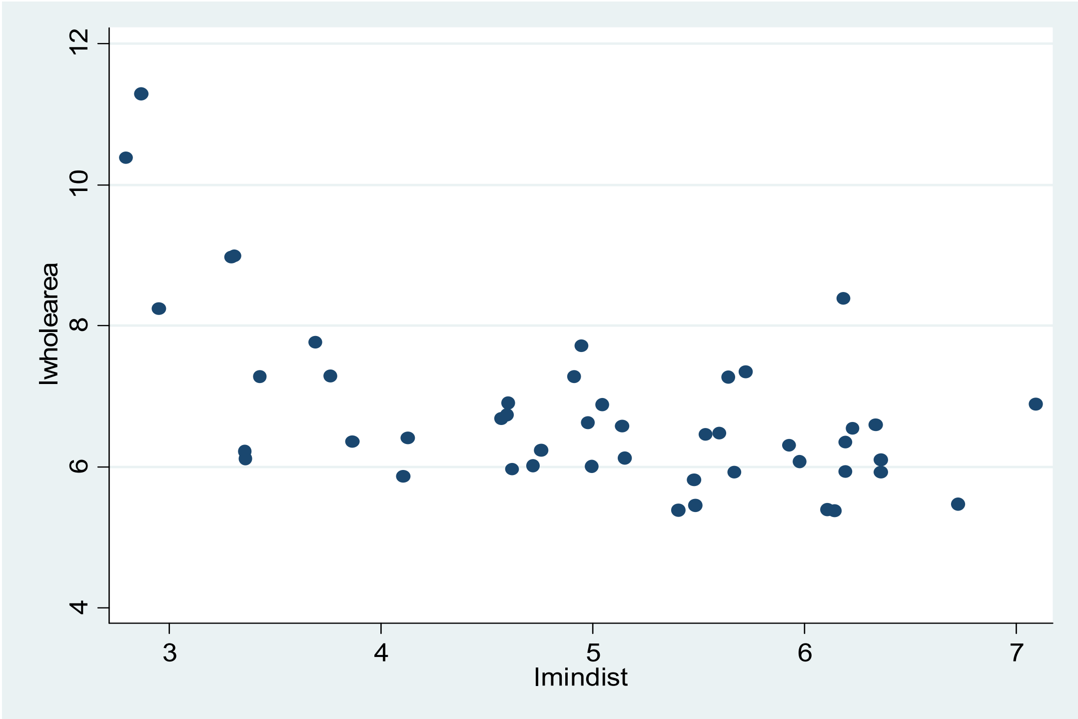
Figure 1: Exporter Productivity Premium and Distance from Core



(Note) Minimum distance from Tokyo or Osaka in logarithm is measured on the horizontal axis.

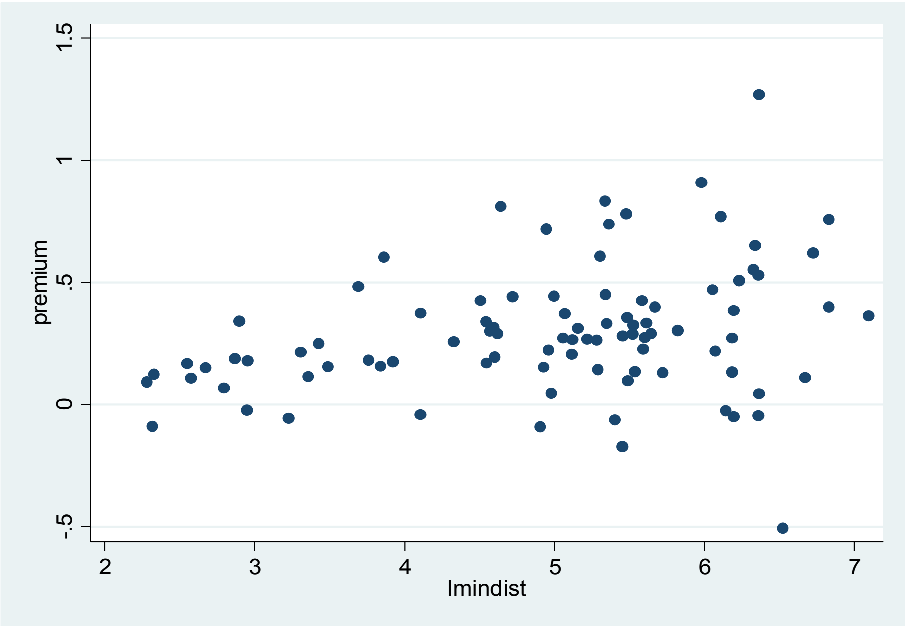
Figure 2: Wholesaler Aceess and Distance from Core



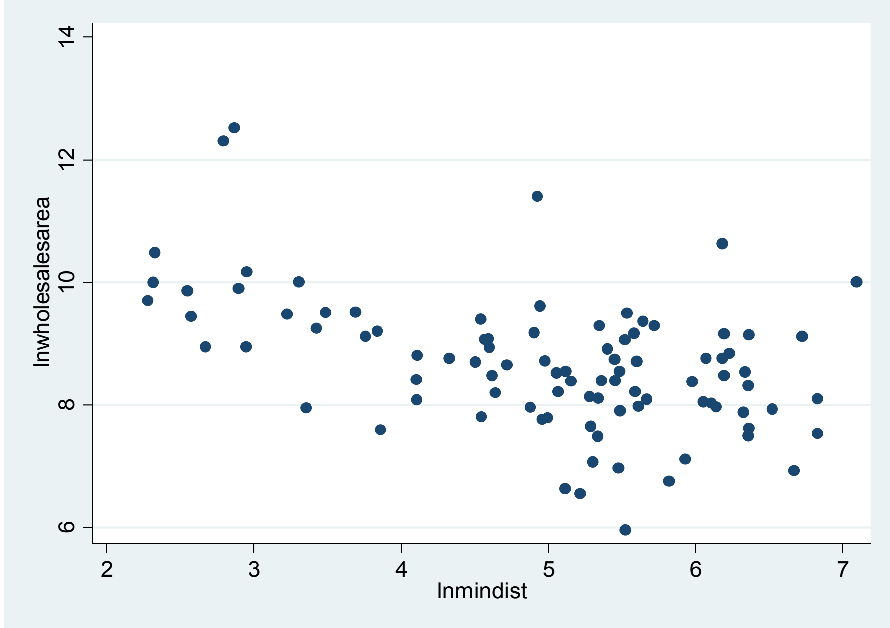
(Note) Minimum distance from Tokyo or Osaka in logarithm is measured on the horizontal axis.
Wholesaler access is measured by wholesaler transaction per sqaure kilometer (in logarithm).

Figutre 3: Exporter Premium, Wholesaler Access and Distance at City Level

Exporter premium



Wholesaler access



(Note) Minimum distance from the core (Tokyo and Osaka) is measured in logarithm.

Figure 4: Productivity Distributions of Exporters and Non-exporters

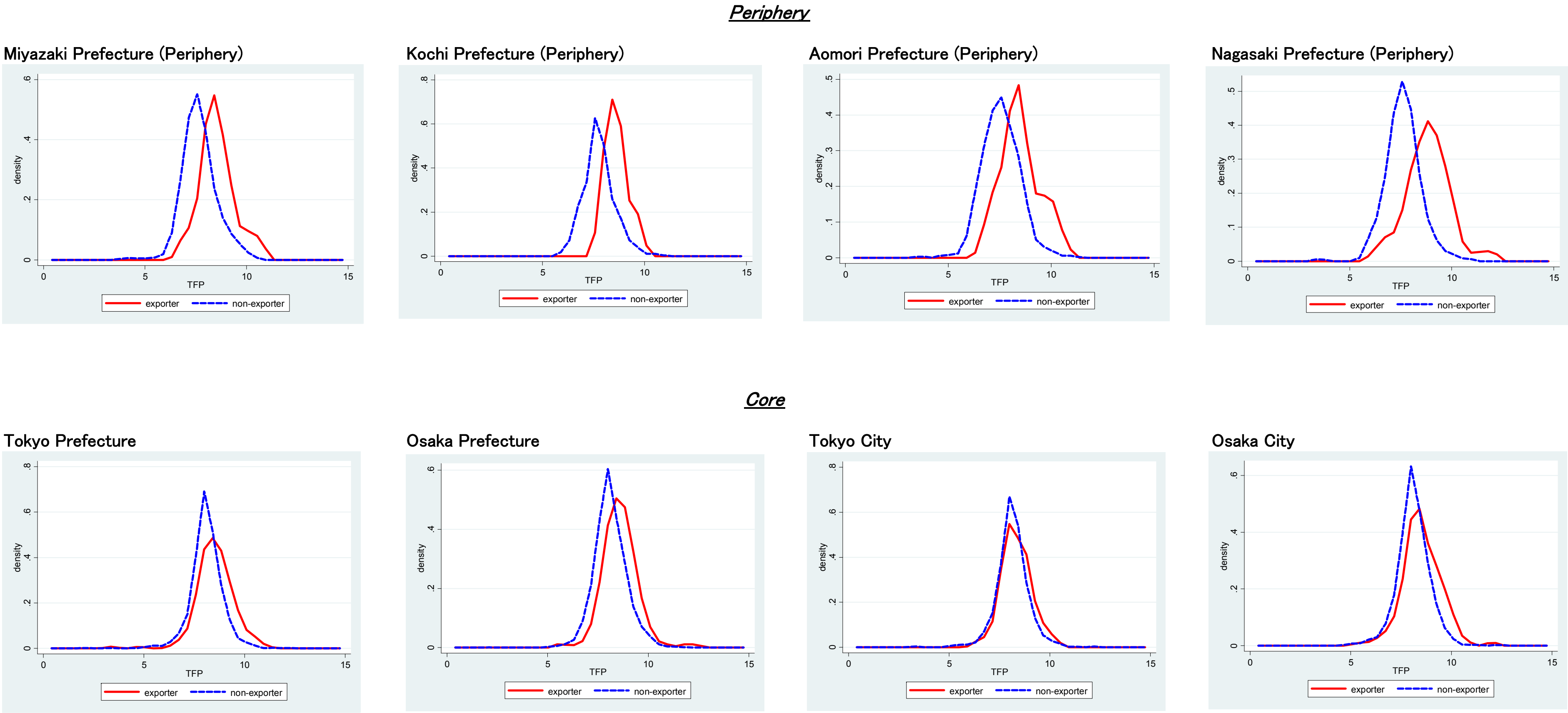
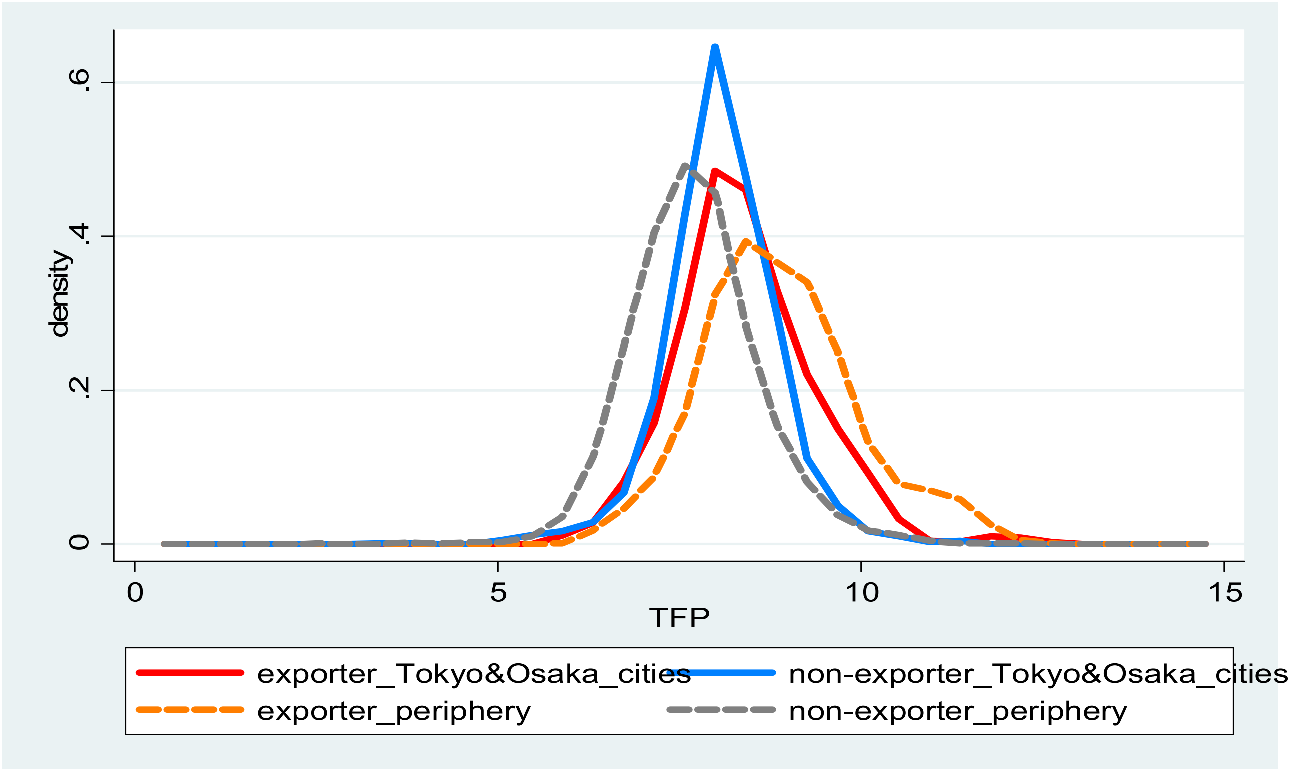


Figure 5: Exporters and Non-exporters in Core and Periphery



Note "Periphery" is defined as prefectures more than 300km from Tokyo or Osaka prefectures excluding prefectures with million populations

Table 1: Basic Statistics

1. Export premium regressions (Prefectural level estimations)

Variable	Obs	Mean	Std.Dev	Min	Max
ExpPrem	47	0.300344	0.12827	0.086009	0.767464
MP	46	14.62583	0.56638	13.52054	16.03332
ExpParticipationReg	47	0.110955	0.041309	0.026338	0.230159
Income	47	7.904988	0.140846	7.621653	8.395555
DIST	47	4.985536	1.140537	2.795177	7.092491
Wholesaler	47	6.772476	1.230913	5.376956	11.29152
KL	47	0.938339	0.697684	−0.62783	3.090251

2. Plant level regressions

	Obs	Mean	Std Dev	Min	Max
EXP	325831	0.099015	0.298682	0	1
KL	325828	5.364978	2.26062	−6.78559	14.03347
TFP	317139	8.059051	0.899087	−5.83914	14.67323
SIZE	325831	4.369859	0.79167	0	9.960671
Wage	325814	5.906991	0.446116	0.750306	12.76187
ExpShareOwn	325830	0.019076	0.09033	0	1
Wholesales	325831	7.417722	1.514512	5.376956	11.29152
ExpParticipationReg	325831	0.045844	0.108657	0	1

Table 2: Regressions of Exporter Premium (Prefectural level estimations)

Dependent variable: ExpPrem

	1		2		3		4	
	coeff	t-value	coeff	t-value	coeff	t-value	coeff	t-value
Dist	0.0595	17.74 ***					0.0297	1.66 *
MP			-0.111	-3.73 ***				
Wholesaler					-0.043	-3.99 ***	-0.0271	-2.01 **
Sample	47		46		47		47	
R-sq	0.872		0.2401		0.1707		0.2175	
F	314.68		13.9		15.9		9.64	

(Note) Statistical significance at 1%, 5%, and 10% are expressed by ***, **, and *, respectively.
(Note) Column 1 is regression without constant term

Table 3 Regressions with Interaction Terms

Dependent variable: TFP

	1			2			3			4		
	coeff	t-value		coeff	t-value		coeff	t-value		coeff	t-value	
EXP	0.26397	39.83	***	0.25285	39.83	***	-0.05834	-1.32				
EXP_Dist							0.07309	7.3	***			
Dist				-0.06964	-23.61	***	-0.0765	-24.72	***			
EXP_Core										0.1648	3.15	***
Exp_Periphery										0.2715	22.28	***
NonEXP_Core										0.0926	4.87	***

(Notes) These are plant-level estimations. All plants at year 2006 are pooled.
Coefficients on other independent variables are omitted (Size, squared Size, KL).
Statistical significance at 1%, 5%, and 10% are expressed by ***, **, and *, respectively.
Core is defined as Tokyo and Osaka cities

Table 4 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	
EXP t-1	2.4526	30.84	***	2.4369	39.86	***	2.4215	76.64	***	2.2901	79.99	***
EXP t-2	1.121	10.41	***	1.1331	16.23	***	1.0491	31.75	***	1.0326	34.96	***
TFP t-1	0.1841	5.28	***	0.1812	7.09	***	0.1743	12.44	***	0.0877	6.66	***
SIZE t-1	0.0614	1.77	*	0.0881	3.38	***	0.0908	6.45	***	0.171	13.1	***
N of obs.	21161			37129			95246			75775		
N of plants	5114			8973			22925			18396		
Log-likelihood	-1495.2			-2521.3			-8663			-9443.8		
Wald Chi-2	2456.06			5027.69			21158			21609.4		

	Tokyo Prefecture			Osaka Prefecture			Tokyo City			Osaka City		
	coeff	z-value		coeff	z-value		coeff	z-value		coeff	z-value	
EXP t-1	2.5409	24.99	***	2.1392	32.28	***	2.5485	18.78	***	1.9989	16.38	***
EXP t-2	1.0244	9.46	***	0.9917	14.6	***	0.9526	6.56	***	1.0276	8.13	***
TFP t-1	0.0271	0.62		0.0554	1.67	*	0.0135	0.22		0.0494	0.82	
SIZE t-1	0.2276	5.02	***	0.2156	6.24	***	0.1725	2.3	**	0.379	5.28	***
N of obs.	7615			13126			4736			3734		
N of plants	1906			3231			1195			931		
Log-likelihood	-786.06			-1739.2			-443.7			-493.78		
Wald Chi-2	1918.61			3555.73			1020.3			871.45		

Estimations with Regional factors

	Periphery 1			Periphery 2			Periphery 3			Core+Surrouding			Tokyo Prefecture			Osaka Prefecture		
	coeff	z-value		coeff	z-value		coeff	z-value		coeff	z-value		coeff	z-value		coeff	z-value	
EXP t-1	2.34345	20.38	***	2.30403	26	***	2.3047	59.98	***	2.21967	68.13	***	2.49988	23.02	***	2.1159	28.51	***
EXP t-2	1.38574	10.46	***	1.42025	13.68	***	1.1255	26.02	***	1.04528	29.14	***	0.991466	7.92	***	1.0269	12.6	***
TFP t-1	0.36262	5.85	***	0.32331	6.75	***	0.2322	11.79	***	0.10565	6.6	***	0.008038	0.18		0.0605	1.57	
SIZE t-1	0.16566	2.67	**	0.18828	3.9	***	0.1473	7.54	***	0.19449	11.92	***	0.266269	5	***	0.1958	4.84	***
Wholesaler	-0.1554	-1.36		0.03018	0.89		0.0436	2.34	**	0.09232	8.73	***	0.158678	4.19	***	0.0649	2.89	***
ExpParticipationReg	8.39432	12.92	***	8.56748	17.13	***	6.6896	34.54	***	5.77689	31.52	***	5.321982	9.04	***	5.6711	12.2	***

(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.
(excluding Okinawa and prefectures having cities with more than one million population: Hokkaido, Miyagi and Fukuoka)
Periphery 2 is defined as prefetcures located more than 300km far from Tokyo or Osaka.
Periphery 3 is defined as prefectures located more than 100km far from Tokyo or Osaka or Nagoya.
Core+Surrounding is defined as Tokyo, Saitama, Chiba, Kanagawa, Aichi, Hyogo, Osaka and Kyoto.

Log likelihood and Wald Chi-2 in the bottom tables are omitted to report to save the space

Table 5: Exit from Exporting

	Periphery 1		Periphery 2		Periphery 3		Core+Surrounding	
	coeff	z-value	coeff	z-value	coeff	z-value	coeff	z-value
TFP	−0.26991	−2.23 **	−0.15992	−1.85 *	−0.08522	−1.87 *	0.061667	1.42
SIZE	−0.11132	−1.18	−0.05275	−0.82	−0.11857	−3.1 ***	−0.26046	−6.35 ***
Wage	0.273841	1.06	−0.07022	−0.4	−0.2292	−2.16 **	−0.15408	−1.45
ExpShareOwn	−1.25961	−3.12 ***	−1.19101	−3.76 ***	−1.33327	−7.85 ***	−1.86584	−8.56 ***
N of obs	1097		1831		7058		7749	
N of groups	319		539		2070		2349	
Loglikelihood	−281.264		−437.789		−1877.99		−2152.76	

	Tokyo Prefecture		Osaka Prefecture		Tokyo City		Osaka City	
	coeff	z-value	coeff	z-value	coeff	z-value	coeff	z-value
TFP	0.313274	1.72 *	0.023736	0.2	0.458984	1.68 *	0.068909	0.36
SIZE	−0.27467	−1.88 *	−0.32414	−2.72 **	0.102435	0.48	−0.375	−1.73 *
Wage	−0.15457	−0.43	−0.0556	−0.18	−0.11775	−0.25	−0.31955	−0.6
ExpShareOwn	−2.25388	−2.71 **	−1.35986	−2.51 **	−4.55516	−3.08 ***	−0.72171	−0.81
N of obs	747		1212		346		329	
N of groups	232		382		115		110	
Loglikelihood	−132.468		−409.749		−67.459		−114.264	

Estimations with Regional Factors

	Periphery 1		Periphery 2		Periphery 3		Core+Surrounding		Tokyo Prefecture		Osaka Prefecture	
TFP	−0.37596	−1.38	−0.42422	−2.07 **	−0.23182	−2.11 **	0.110299	1.53	0.0982	0.64	−0.0718	−0.4
SIZE	−0.77379	−2.27 **	−0.25342	−1.49	−0.43481	−4.5 ***	−0.42478	−6.19 ***	−0.4028	−2.45 **	−0.2394	−1.39
Wage	0.357994	0.56	−0.05448	−0.13	−0.173	−0.69	−0.15376	−0.91	−0.0963	−0.3	−0.0448	−0.1
ExpShareOwn	−2.80433	−2.3 **	−2.39032	−3.16 ***	−2.60373	−6.66	−2.05556	−6.33 ***	−2.2247	−2.77 ***	−1.0221	−1.35
Wholesaler	−0.05994	−0.1	−0.16698	−1.2	−0.19847	−1.72 *	−0.2015	−4.29 ***	−0.209	−2.49 **	−0.0695	−1.71 *
ExpParticipationReg	−19.6483	−3.99 ***	−17.2653	−6.98 ***	−21.3957	−14.8 ***	−16.3227	−13.51 ***	−10.6624	−4.51 ***	−20.2256	−5.26 ***

(Notes) Year dummies and sector dummies are included but omitted.
All independent variables are one-year lagged. All exporters at the previous year are covered.
Dependent variable is dummy for exit of exporting. If a plant stops export, the dummy takes unity.
N of Obs, N of groups and Loglikelihood are omitted to report in bottom tables to save space.

Table 6: Multi-plant v.s. Single-plant in TFP Impacts

Export Decision (Estimated TFP and Wholesaler Access Coefficients Only)

		Periphery 1	Periphery 2	Periphery 3	Core+Surrounding	Tokyo Prefecture	Osaka Prefecture
		Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
Multi-plant	TFP	0.4351 ***	0.3938 ***	0.2198 ***	0.0949 ***	−0.0133	0.0664
	Wholesaler Access	−0.1995	−0.0001	0.0098	0.0545 ***	0.0745 **	0.0381 ***
Single-plant	TFP	0.3263 ***	0.2788 ***	0.2739 ***	0.1226 ***	0.0327	0.0916
	Wholesaler Access	−0.1477	0.0543	0.0706 *	0.0375 ***	0.0606 *	0.0009 *

(Notes) All other variables are omitted.
z-values are omitted

Table 7: Heckman Two-step Estimations and Selection Bias

	Periphery 1			Periphery 2			Periphery 3			Core+Suroundings			Tokyo and Osaka		
Export Share Own															
EXP t-1	0.14773	13.22	***	0.144442	26.15	***	0.137155	76.75	***	0.108479	71.79	***	0.101023	38.96	***
EXP t-2	0.070489	6.15	***	0.063708	11.26	***	0.065265	35.73	***	0.052904	34.32	***	0.043677	16.51	***
TFP	0.007589	2.33	**	0.005352	3.85	***	0.005287	10.18	***	0.001503	3.35	***	0.001214	1.37	
SIZE	0.008236	2.95	***	0.006748	4.99	***	0.00676	13.68	***	0.010942	25.64	***	0.007379	9.8	***
Survival(1st step estimation)															
TFP	0.116786	3.9	***	0.084117	4.48	***	0.069452	5.48	***	0.079107	6.78	***	0.054395	2.77	**
SIZE	0.121051	4.01	***	0.115765	5.5	***	0.096005	7.32	***	0.062698	5.19	***	0.021545	1	
Wage	0.066932	1.22		0.073566	2.04	**	0.089086	3.73	***	-0.00598	-0.26		0.05218	1.3	
KL	0.029268	3.59	***	0.029316	4.97	***	0.03154	8.42	***	0.045578	12.38	***	0.028524	3.79	***
mills lambda	0.217328	1.63	*	0.138783	2.18	**	0.086422	3.59	***	0.020034	1.2		-0.03797	-0.92	
rho	1			1			1			0.26331			-0.54484		
sigma	0.217328			0.138783			0.086421			0.076083			0.069693		
Obs	22296			39241			100395			80600			22439		
uncensored obs	21681			38058			97460			77586			21347		
Wald	1254.27			4752.06			42835.18			38036.37			9714.72		

	Tokyo Prefecture			Osaka Preefcture			Tokyo City			Osaka City		
Export Share Own												
EXP t-1	0.122898	7.34	***	0.087659	29.2	***	0.095964	10.7	***	0.076297	11.16	***
EXP t-2	0.050206	2.9	**	0.040169	13.24	***	0.024773	2.65	***	0.023233	3.36	***
TFP	-0.00073	-0.15		0.002438	2.12	**	0.001969	0.92		0.000499	0.19	
SIZE	0.007477	1.48		0.006116	6.7	***	0.000838	0.27		0.005986	2.15	***
Survival(1st step estimation)												
TFP	0.020402	0.73		0.082258	2.87	***	-0.02646	-0.67		0.065928	1.31	
SIZE	0.026294	0.84		0.012625	0.43		-0.03514	-0.8		-0.09373	-1.69	*
Wage	0.048689	0.77		0.071041	1.33		0.089551	1.09		0.249484	2.39	**
KL	0.013323	1.12		0.035137	3.59	***	0.01194	0.84		0.027978	1.44	
mills lambda	-0.27403	-0.59		0.009044	0.22		0.112165	0.6		-0.08857	-1.21	
rho	-1			0.13932			1			-1		
sigma	0.274034			0.064914			0.112165			0.088574		
Obs	8333			14106			5245			4040		
uncensored obs	7867			13480			4919			3843		
Wald	374.19			5313.71			632.95			648.91		

(Notes) Sector dummies and year dummies are omitted to report

Table 8: Treatment Effect of Exporting

	ATT			Robustness--with regional factors ATT		
	Difference	t-value		Difference	t-value	
Periphery 1	0.2329	2.96	**	0.2522	3.15	***
Periphery 2	0.19798	3.34	***	0.1634	2.65	**
Periphery 3	0.16203	5.84	***	0.1889	6.68	***
Core+Surrounding	0.1168	4.26	***	0.18	6.59	***
Tokyo Prefecture	0.14271	1.53		–	–	
Osaka Prefecture	0.06055	0.95		–	–	
Tokyo City	0.06928	0.61		–	–	
Osaka City	0.03879	0.31		–	–	
All Japan	0.14441	8.17	***	0.16722	9.49	***

(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 wage, size, size squared, multi-plant dummy, and sector dummies.
In addition first-stage regressions in with-regional factors also include regional variables, i.e. Wholesalers and ExportParticipationReg

Appendix Table A1: Number of Plants (Year 2008)

Prefecture	Name	Num of plants	Num of exporters
1	Hokkaido	1225	31
2	Aomori	411	21
3	Iwate	697	38
4	Miyagi	772	60
5	Akita	535	33
6	Yamagata	765	65
7	Fukushima	1185	104
8	Ibaraki	1537	167
9	Tochigi	1143	140
10	Gunma	1196	117
11	Saitama	2523	331
12	Chiba	1323	194
13	Tokyo	1643	234
14	Kanagawa	2088	374
15	Niigata	1313	152
16	Toyama	782	75
17	Ishikawa	600	50
18	Fukui	443	70
19	Yamanashi	456	75
20	Nagano	1291	294
21	Gifu	1287	151
22	Shizuoka	2422	323
23	Aichi	3648	463
24	Mie	990	146
25	Shiga	874	144
26	Kyoto	832	124
27	Osaka	2917	391
28	Hyogo	2092	314
29	Nara	375	53
30	Wakayama	334	36
31	Tottori	263	27
32	Shimane	269	25
33	Okayama	933	118
34	Hiroshima	1152	132
35	Yamaguchi	584	76
36	Tokushima	255	32
37	Kagawa	454	25
38	Ehime	530	54
39	Kochi	197	16
40	Fukuoka	1391	143
41	Saga	396	37
42	Nagasaki	324	26
43	Kumamoto	539	44
44	Oita	424	27
45	Miyazaki	408	25
46	Kagoshima	468	21
47	Okinawa	169	6
	All Japan	46455	5604

Appendix Table A2: Exporter Premium of Each Prefecture

Prefecture Code	Name	Pooled OLS coefficient	Pooled OLS t-value	Fixed effect coefficient	Fixed effect t-value
1	Hokkaido	0.438919	6.61	−0.010857	−0.16
2	Aomori	0.528875	6.01	−0.016941	−0.21
3	Iwate	0.233276	4.56	0.2032019	3.79
4	Miyagi	0.360411	8.3	0.009416	0.17
5	Akita	0.555049	10.6	0.0709859	1.51
6	Yamagata	0.39104	12.27	−0.06106	−2
7	Fukushima	0.283212	9.7	−0.026763	−0.9
8	Ibaraki	0.297982	10.31	0.0674577	2.21
9	Tochigi	0.275421	8.71	0.1026012	2.92
10	Gunma	0.272476	8.94	0.0943801	3.39
11	Saitama	0.203389	11.31	0.0450206	2.39
12	Chiba	0.287902	10.82	0.0836773	3.07
13	Tokyo	0.185269	8.48	0.0945356	3.42
14	Kanagawa	0.213629	11.95	0.0251975	1.21
15	Niigata	0.211715	9.13	0.0379527	1.57
16	Toyama	0.247025	6.71	0.0163423	0.51
17	Ishikawa	0.16262	3.61	0.0418471	0.91
18	Fukui	0.242197	6.16	0.1494723	3.99
19	Yamanashi	0.329286	8.45	0.0110442	0.29
20	Nagano	0.316567	16.51	0.0495839	2.43
21	Gifu	0.196028	8.29	0.0359733	1.61
22	Shizuoka	0.267849	13.68	0.0604452	3.05
23	Aichi	0.191745	12.05	0.0457762	3.01
24	Mie	0.369684	11.05	0.0464136	1.33
25	Shiga	0.300589	9.62	0.0812935	2.58
26	Kyoto	0.257184	7.88	0.034855	1.26
27	Osaka	0.135303	8.79	0.023391	1.46
28	Hyogo	0.227204	10.64	0.078662	3.67
29	Nara	0.186558	3.69	0.0253207	0.58
30	Wakayama	0.153603	2.15	−0.087588	−1.32
31	Tottori	0.418114	6.09	0.0491475	0.84
32	Shimane	0.175725	2.78	0.102958	1.87
33	Okayama	0.28324	8.54	0.0364631	1.18
34	Hiroshima	0.31743	10.32	0.0764435	2.4
35	Yamaguchi	0.428968	10.78	0.1402734	3.1
36	Tokushima	0.528156	7.6	0.1682803	2.82
37	Kagawa	0.342167	5.33	0.0873557	1.49
38	Ehime	0.086009	1.65	0.0565326	1.08
39	Kochi	0.37569	4.18	0.1427631	1.65
40	Fukuoka	0.208218	6.93	0.0415096	1.33
41	Saga	0.242298	4.48	0.0474921	0.99
42	Nagasaki	0.313124	4.52	0.2343413	3.33
43	Kumamoto	0.290195	6.08	0.0450429	0.87
44	Oita	0.767464	12.17	0.1665851	2.99
45	Miyazaki	0.489354	6.79	0.0352105	0.55
46	Kagoshima	0.364247	4.49	0.1523742	2.2
47	Okinawa	0.16378	0.88	−0.454925	−2.11
All Japan		0.274312	59.58	0.0542737	11.5

Appendix Table A3: Agglomeration Indices

Export Decision

	Periphery 1			Periphery 2			Periphery 3			Periphery 4			Core+Surrouding		
	coeff	z-value		coeff	z-value		coeff	z-value		coeff	z-value		coeff	z-value	
EXP t-1	2.3473	20.39	***	2.3061	25.98	***	2.3001	59.81	***	2.181	43.77	***	2.2036	69.23	***
EXP t-2	1.3897	10.47	***	1.4238	13.69	***	1.1209	25.92	***	1.1235	20.37	***	1.0604	30.34	***
TFP t-1	0.369	5.92	***	0.332	6.88	***	0.2266	11.48	***	0.1491	5.86	***	0.1071	6.8	***
SIZE t-1	0.1652	2.66	**	0.1882	3.89	***	0.1517	7.73	***	0.1584	6.24	***	0.1918	11.99	***
KS	7.5283	0.29		-18.9948	-1.77	*	3.1011	3.51	***	11.2712	2.72	***	6.2939	2.57	***
ENTRPY	-0.5768	-1.8	*	-0.2208	-0.86		0.4889	4.28	***	-0.6418	-2.14	**	0.4344	3.17	***
Wholesaler	-0.3097	-1.02		0.0665	1.59		0.022	1.1		0.0981	1.43		0.0666	5.16	***
ExpParticipationReg	8.4334	12.94	***	8.6023	17.16	***	6.7118	34.6	***	6.5892	24.04	***	5.8295	32.55	***

Exit from Exporting

	Periphery 1			Periphery 2			Periphery 3			Periphery 4			Core+Surrounding		
	coeff	z-value		coeff	z-value		coeff	z-value		coeff	z-value		coeff	z-value	
TFP	-0.3756	-1.5		-0.4559	-2.09	**	-0.2109	-1.92	*	-0.1577	-0.83		0.1121	1.57	
SIZE	-0.7398	-2.35	**	-0.2588	-1.42		-0.4307	-4.46	***	-0.3365	-1.97	*	-0.4254	-6.23	***
Wage	0.4341	0.72		-0.0661	-0.15		-0.1639	-0.65		-0.5923	-1.44		-0.1733	-1.02	
ExpShareOwn	-2.5945	-2.33	**	-2.5314	-3.17	***	-2.6152	-6.77	***	-4.0807	-4.66	***	-2.056	-6.36	***
KS	-237.4	-1.95	*	-1.6146	-0.04		-3.7225	0.77		-31.284	-0.95		-30.854	-2.58	**
ENTRPY	4.227	2.12	**	1.3656	1.1		-2.3408	-3.32	***	-2.4718	-1.02		-0.9077	-1.51	
Wholesaler	2.7432	1.88	*	-0.2624	-1.44		-0.0245	-0.2		0.0558	0.1		-0.2367	-3.95	***
ExpParticipationReg	-18.1795	-3.96	***	-18.3411	-7.63	***	-21.317	-15.46	***	-38.0475	-10.86	***	-16.282	-13.44	***

Notes: Periphery 4 is defined as prefectures with less than 100km from Tokyo or Osaka except prefectures of Core+Surrounding
KS and Entropy Indices are prefectural level variables and based on the number of establishments