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Does Export Yield Productivity and Markup Premiums? Evidence from the Japanese manufacturing industry

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Does Export Yield Productivity and Markup Premiums? Evidence from the Japanese manufacturing industry[***]

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Abstract

This paper examines the relationship between productivity, markups, and development of foreign markets using a rich firm-level dataset of the Japanese manufacturing industry during the period 2000-2010. Using estimates of firm-specific productivity and markups, we investigate if the development of foreign markets through exports has a premium for their market performance. Our study confirmed that exports have significant productivity and markup premiums. In addition, export premiums vary across the destination markets. Exports to Asia show a significant productivity premium while other markets do not. For markups, exports to Asia and North America have a significant premium. These findings imply that both productivity and markups should be considered in assessing the development of foreign markets.

Keywords: Productivity, Markups, Exports
JEL Classification Code: F14, L11

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1. Introduction

As the globalization develops, trade structure has become complicated through construction of sophisticated production networks. During the last couple of decades, firms sliced up their production processes, allocated them to different countries following comparative advantages and connected them as value chains by trade and foreign direct investment (FDI). This structural change has attracted many policy makers and economists, and generated a large amount of research by micro approaches as well as macro ones. In particular, studies using the micro level data drastically increased by theoretically incorporating firm heterogeneity into trade models. This paper is a part of those empirical studies. Using a firm-level data of the Japanese manufacturing industry, we examine the relationships between firm heterogeneity and development of foreign markets.

Firm heterogeneity has been incorporated into trade models since the last decade. The seminal papers by Melitz (2003) and Helpman et al. (2004) opened new frontiers for both theoretical and empirical economists on international trade. Relying on the Dixit-Stiglitz monopolistic competition, they described firm level activities. For the relations between trade and productivity, the latter suggested that the most productive firms selected FDI, the second productive firms rely on export, the third focus on the domestic market and the least productive firms should be ruled out of the market. In addition, Melitz and Otttaviano (2008) (henceforth MO) analyzed the relations between the market size and productivity, and also focused on the markup, extending the above model. This model expected that the larger, the more integrated markets exhibit higher productivity and lower markup.

These theoretical predictions have been carefully examined in many empirical papers and positive relations between export decision and productivity were detected. Bernard et al. (2012) surveyed the contributions of those papers. The implications of M O were also examined by Bellone et al. (2008). In their study, French industry data gave favourable evidence for the theoretical expectations. Loecker and Warzynski (2012) also found positive relations between markups and export in Slovenian manufacturing firms. As for Japanese firms, Wakasugi et al. (2014) discussed the relationships between productivity and the mode of internationalization. It showed that productivity of internationalized firms are higher than that of non-internationalized one as theoretical models expected although the gap between them is smaller than that in European firms. In addition, the exporters to multiple regions show higher productivity than exporters to a single region. Kato and Kodama (2011) examined the implications of MO using data of the Japanese small and medium size enterprises (SMEs). Their paper revealed that the prediction of the relations between the market size and productivity is also applicable to SMEs in the service sector.

Although those studies provided a great deal of contributions to our understandings of activities of firms, there still remain some problems. Since firms are thought to maximize their profits, some possibly put their priorities on differentiating their products from others rather than improving technical efficiency. For those firms, productivity is not always high if productivity is defined as the ratio between output and inputs[1]. But they can still explore the foreign markets through export and FDI. Another problem is that many existing papers didn't incorporate differences in export markets into their analysis. However, export to the countries within production networks may be considerably different from export to the consumer's market. The existing papers do not

[1] Some firms (i.e. fashion brand) use old fashioned technologies such as handcrafting on purpose, to keep the established consumer's valuation.

sufficiently discuss these issues. Thus, our study is designed to fill these gaps to some extent, using estimates of both productivity and markup at the firm level.

The layout of this paper is as follows. The next section, we briefly explain the estimation method used in this paper and regression models. Section 3 describes data. In Section 4, we discuss empirical results. And the last section concludes this study.

2. Empirical Framework

This section briefly explains the methodology to estimate the firm-specific productivity and markup, and describes the regression model. As we mentioned above, this paper explicitly discusses heterogeneity in both productivity and pricing power across firms. A problem here is that the firm level price information is not available. To overcome this problem, we estimate both productivity and markup at the firm level following Martin (2010) (details are in Appendix)[2]. In this approach, the production of each firm is represented as a Cobb Douglass production function, demand for each firm's products is given as a simple demand function and all firms are assumed to maximize their profits under heavy competition. Then, the revenue function for each firm is defined as follows,

$$r_i - \sum_{X \neq K} \bar{s}_{Xi} \left(x_i - k_i \right) = \tilde{r}_i = \gamma \frac{\overline{1}}{\mu_i} k_i + \frac{\overline{1}}{\mu_i} \left(\lambda_i + a_i \right) + \tilde{\varepsilon}_i \qquad (1),$$

where the subscript i means firm i, and $i = 1, \ldots n$[3]. Lower case variables denote log

[2] This approach is also applied to Kato (2010a, 2010b) and Kato and Kodama (2014). Thus, the explanation of the methodology in this section also refers to them.

[3] Our estimation implicitly assumes that the price of each input is identical across firms. Although this assumption is very restrictive and ad hoc, Eslava et al. (2005) reveals that ignoring input prices give little effects on productivity estimation using Columbian data.

of deviation from the reference firm for each variable. r, s, γ and μ are the total revenue, the revenue share of variable, the degree of returns to scale and the firm-specific markup, respectively. Here γ is assumed to be positive and identical across firms in each industry but not necessarily equal a unity. In addition, x is a temporary adjustable input such as labour and intermediates. k is capital and assumed to be fixed for the short run as well as many existing papers on productivity analysis. λ and a are respectively consumers' valuation of firm *i*'s product and technical efficiency. Using them, firm-specific quality adjusted productivity is represent as $\omega_{\mathrm{i}} = (\lambda_i + a_i)$.

In estimation of a production (and revenue) function, ω is possibly correlated with capital[4]. If so, an estimate of ω is not statistically consistent. To solve this problem, we apply a control function approach following Olley and Pakes (1996), Levinsohn and Petrin (2003), Bond and Söderbom (2005), and Ackerberg et al. (2006)[5], using capital and net revenue to approximate ω. Since there is no information on the degree of γ, we can only estimate ω/γ. However, it gives no bias in discussion below because γ is assumed constant across firms. On the other hand, markup is represented as a function of revenue share and adjustable input factors. That is,

$$\frac{1}{\mu_i} = s_{xi}\left(\frac{\partial \ln F_i}{\partial \ln X_i}\right)^{-1} = s_{xi}\Psi(\mathbf{X}_i) \qquad (2),$$

where F and $\mathbf{X}$ are the production function and the vector of inputs, respectively.

4 Ichimura, Konishi and Nishiyama (2011) discusses the case that labour is also correlated to productivity.

5 Wooldridge (2009) proposes another approach using GMM.

Since the functional form of $\Psi(\cdot)$ is also unknown, it is approximated in the same manner to ω. For markup, we obtain μ/γ as well as the firm-specific quality adjusted productivity.

Using these estimates of relative productivity and markup, we examine the export premium as follows,

$$\text{Productivity}_{\text{it}} = \beta_0 + \beta_1 Export_{it} + \beta_2 (Export + FDI)_{it} + \sum \beta_j Z_{it} + \varepsilon_{it} \quad (3),$$

$$\text{Markup}_{\text{it}} = \delta_0 + \delta_1 Export_{it} + \delta_2 (Export + FDI)_{it} + \sum \delta_j Z_{it} + \epsilon_{it} \quad (4),$$

where Export, and Export + FDI are dummies equal to a unity if firm i relies on export only and Export + FDI to develop foreign markets, respectively[6]. Z is the set of control variables including the firm size, the firm age and the foreign ownership. The firms that explore foreign markets by export and by export and FDI are separately examined because their forms of export are possibly different[7]. A problem in estimation of equations is that the residuals are not independent across firms within each industry. In that case, t-values are overstated. In order to solve this problem, we use clustered robust standard errors at the firm level following Smeets and Warzynski (2013).

Export premium is also examined by region. That is,

$$\text{Productivity}_{\text{it}} = \eta_0 + \sum \eta_h Region_{hit} + \sum \eta_j Z_{it} + \nu_{it} \quad (5),$$

6 The firms that explore foreign markets only by FDI are also controlled by a dummy variable and that dummy is included in the set of control variables.

7 The dummy of export + FDI may control the firms that are engaged in intra-firm trade.

$$\text{Markup}_{it} = \xi_0 + \sum \xi_h Region_{hit} + \sum \xi_j Z_{it} + \upsilon_{it} \qquad (6),$$

where Region is the dummy to identify the export destination and equals a unity if firm i export its products to h. In this study, we divide the global market into the following three regions, Asia, North America (NA) and the rest of the world (ROW). Thus, the possible export destinations are Asia only, NA only , ROW only, Asia+NA, Asia+ROW, NA+ROW, and the global market. This estimation is expected to detect that the role of each foreign market possibly varies each other.

3. Data

The data used in this paper are obtained from the microdata pertaining to Basic Survey of Business Structure and Activity (BSBSA)[8]. Following many existing papers using this statistics, total sales and the tangible fixed assets are proxies of total revenues of firms (R) and capital (K), respectively. The number of employees is also obtainable from BSBSA and the average working hours at the industry level are in Monthly Labor Survey. Following Morikawa (2010), we calculate man-hours by employment status and sum up them. On the other hand, labour cost is represented as total wages. The proxy of intermediate input is constructed as follows,

$$Intermediate\ Input = COGS + SGA - (TW + Dep + T\ \&\ D) \qquad (7),$$

where *COGS*, *SGA*, *TW*, *Dep* and *T&D* are the cost of goods sold, the selling and

[8] This statistics is annually compiled by the Ministry of Economy, Trade and Industry (METI) Japan and covers the firms whose employees are more than 50 or capital is over 30 million Japanese yen.

general administrative expenses, the total wages, the depreciation and the tax and dues, respectively[9]. In our data construction, the observations whose number of regular workers, tangible fixed assets, total wages, or intermediate inputs is zero or negative are excluded. BSBSA also provides the data of export values and the number of overseas affiliates. Using these data, we construct dummies of export and FDI.

Table 1 presents the number of observations by industry. It says that the majority of firms operate their business only in the domestic market while the dependency ratios on the domestic market significantly vary across industries. Firms in light industries highly rely on the domestic market while those in chemical and high-tech industries aggressively explore oversea markets, mainly by export.

Among export destinations, the large majority of exporters go to Asia. This is consistent with the trade statistics in terms of values. In 2010, Asia accounted for 56.1 percent of Japan's export values. North America is the second largest destination. In 2010, 16.6 percent of Japan's export went to this region[10]. It seems to justify division of regions in this paper.

4. Empirical Results

In this section, we describe empirical results and discuss their implications. Table 2 is a summary of productivity and markup estimation by industry. The estimated productivity and markup are relative values to the reference firm in each industry whose productivity and markup are zero and a unity, respectively[11]. It shows that the market structure considerably varies across industries. Foods and Beverages, Woods and Papers, General

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9 Tokui, Inui and Kim (2007) and Kim, Kwon and Fukao (2008).
10 Trade Statistics of Japan
11 The reference firm is the median in terms of man-hour revenue in the initial year.

Purpose Machinery and Electronic Parts, Devices & Electronic Circuits have relatively positive correlations between productivity and markup. In these industries, firms with higher productivity also have higher markup. On the other hand, Textile, Plastic and Rubber Products, Glasses and Ceramics, Information and Communication Electronics, and Miscellaneous Products show relatively negative correlations. It implies that firms focus on either technical efficiency or pricing power. In other industries, the correlations between them are near zero.

Figures 1 and 2 illustrate the kernel density distributions of productivity and markup by activity. They indicate that development of foreign market by export is positively related to both productivity and markup as theoretical models expect. Figures 3 and 4 also illustrate the kernel density distribution of productivity and markup by export destination. For productivity, the firms develop the global market seems to have higher productivity while it is difficult to identify which region is higher than others for markup. It is, however, confirmed that non exporters seem to have relatively lower productivity and markup even in these figures.

To statistically discuss these findings, we also estimate equations 3, 4, 5 and 6. The results of those estimations are in Table 3. It reveals that export generates both productivity and markup premiums as theoretical models expected. In addition, the firms engaged both in export and FDI have higher premiums than those engaged only in export. These findings imply that export promotion policy can help an increasing in productivity levels and product differentiation of exporters. In addition, construction of intra-firm supply chain networks is positively related to both productivity and pricing powers.

The two columns in the right hand side of the table present the estimation results of equations 5 and 6. They show that both exporters' premiums of productivity and markup vary across export markets. Firms have productivity premium only if they export their products to the markets including Asia. On the other hand, we can find markup premium in Asia and NA. This result may reflect different roles of the regions for Japanese firms. Many Japanese firms have constructed production networks across Asian countries such as ASEAN members, China, South Korea and Taiwan. To effectively utilize such networks, firms should have high technical efficiency. On the other hand, North America, particularly the US is the largest market of finished goods for many Japanese firms. To sell their finished products in foreign markets, established brand names can play important roles as well as efficient production technologies. These findings imply that export promotion policy should be carefully considered region by region.

5. Concluding Remarks

This paper estimates both productivity and markup at the firm level and examines premiums of them on firms by export. Our findings suggest that markup as well as productivity should be considered in discussion about development of external markets by firms. Since firms can maximize their profits through differentiating their products as well as increasing technical efficiency, different approaches to foreign markets, export may reflect differences in their profit maximization strategies. In addition, firms give different roles to different export markets. Thus, the required advantages to explore oversea markets are also different across regions. Comparing analysis of productivity estimates to that of markup, we can discuss this issue in details. It is also expected to give some useful implications for devising industrial policies to support firm's activities in foreign markets.

For further discussion, differences in production stages should be incorporated into this study. As is already known, exports at the different production stages have different roles in firm's export strategies, and may face different competition environments. Capital and equipment goods, or parts and components are thought to be somewhat poorly substitutable while consumption goods are easily substituted. This difference may require different advantages for exporters.

The role of exchange rate changes should also be carefully examined. Since exchange rate changes significantly affect exporter's price competitiveness, required advantages of firms for export and FDI, and for export to each market may be changed as well. In the long run, it may lead industrial structural changes in both domestic and foreign markets. This issue has been discussed using the macro or the industry level data so far. However, it should be discussed by the firm level data as well.

Appendix

The model and the estimation method used in this paper are explained following Martin (2010).

Model

First, we assume that a firm follows a simple form of Hicks neutral production function,

$$Q_i = A_i \left[f\left(\mathrm{X}_i\right)\right]^{\gamma} \qquad \text{(A1)},$$

where Q_i, A_i, X_i are quantity of output, Hicks-Neutral technology, a vector of inputs, respectively. γ is the degree of returns to scale and $\gamma > 0$. Applying the mean value theorem, equation (A1) is represented as follows,

$$q_i = a_i + \sum_{X_i} \alpha_{X_i} x_i, \quad \text{s.t.} \quad \alpha_{X_i} = \gamma f_{X_i}\left(\overline{\mathrm{X}}_i\right)\frac{\overline{X}_i}{f\left(\overline{\mathrm{X}}_i\right)} \qquad \text{(A2)}^{12}$$

where lowercase means log deviation of each variable from the median firm ($q_i = \ln Q_i - \ln Q_*$: * denotes the median firm)[13].

Secondly, the utility of a representative consumer is denoted as the following differentiable non-convex function,

$$U = U\left(\tilde{Q}, Y\right) \qquad (3)$$

where $\tilde{Q}$ is a $\mathrm{m} \times 1$ vector of quality evaluated units ($\tilde{Q}_i$) of the consumed products, and Y is income[14]. $\tilde{Q}_i = \Lambda_i Q_i$ (the product of consumer's valuation of the quality and the quantity for firm i's product). Suppose each firm faces downward sloping demand curves conditional on actions of other firms, then the demand function is written as follows,

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12 *X is the adjustable inputs in the short run.*

13 In this paper, the median firm is selected based on the revenue per unit labour (man-hour).

14 m is the number of differentiated products.

$$Q_i = D(P_i) \quad \text{(A4)}^{15}.$$

From equation (4), the price elasticity of demand for firm i's product is obtained as $\sigma_i = -\frac{\partial \ln D(P_i)}{\partial \ln P_i}$. Using it, the markup of firm i is defined as $\mu_i = \frac{1}{1-\frac{1}{\sigma_i}}$.

Thirdly, firm i's profit (Π_i) is written as follows,

$$\Pi_i = P_i(Q_i)\cdot Q_i - C_i(\mathrm{X}_i) \quad \text{(A5)},$$

where $C_i(\mathrm{X}_i)$ is the cost function of firm i. Since we assume all firms follow the profit maximisation principle, the following first order condition is obtained,

$$P_i(Q_i)\left(\frac{\gamma Q_i}{f(\mathrm{X}_i)} f_X(\mathrm{X}_i)\right) + P'(Q_i)\frac{\gamma Q_i}{f(\mathrm{X}_i)} f_X(\mathrm{X}_i)Q_i = C_{Xi}(\mathrm{X}_i) \quad \text{(A6)}.$$

Using $C_{Xi}(\mathrm{X}_i) = W_X$ (W_X is the marginal cost of X) and μ_i, equation (6) is rewritten as follows,

$$P_i\gamma\frac{Q_i}{f(\mathrm{X}_i)} f_X(\mathrm{X}_i) = \mu_i W_X \quad \text{(A7)}.$$

From equations (A2) and (A7), we obtain the following relation,

[15] Caplin and Nalebuff (1991)

$$\alpha_{X_i} = \mu_i \frac{W_X X_i}{P_i Q_i} = \mu_i s_{Xi} \qquad \text{(A8)},$$

where s_{Xi} represents the revenue share of X for firm i. Equation (8) indicates that the firm-specific mark-up is obtained as a function of the revenue shares as follows,

$$\mu_i = \Psi(s_{Xi}) = \frac{1}{s_{Xi}} \alpha_{X_i} \qquad \text{(A9)}.$$

On the other hand, firm i's revenue ($R_i = Q_i \times P_i$) is determined by production and demand, and is represented as a function of them, $R_i = R(\mathrm{X}_i, \Lambda_i, A_i)$. Applying the mean value theorem, it is also re-written as follows,

$$r_i = \sum_{\mathrm{X}} \overline{\alpha}_i^X x_i + \overline{\alpha}_i^\Lambda \lambda + \overline{\alpha}_i^A a + \varepsilon_i \qquad \text{(A10)},$$

where $\alpha_i^X = \frac{\partial \ln R_i}{\partial \ln X_i}$ and $\overline{\alpha}_i^X = \frac{\alpha_i^X + \alpha_*^X}{2}$. ε_i is an iid shock.

Among the input variables, capital (k) is usually assumed to be fixed at least in the short run. For adjustable factors, $\frac{\partial \ln Q_i}{\partial \ln X_i} \cdot \frac{1}{\mu_i} = \frac{\partial \ln R_i}{\partial \ln X_i} = s_{Xi}$. In addition, the relations, $\frac{\partial \ln R_i}{\partial \ln \Lambda_i} = \frac{\partial \ln R_i}{\partial \ln A_i} = \frac{1}{\mu_i}$ is satisfied because the demand function $D(\cdot)$ is monotone in price and Λ_i is consumption-augmenting. From these relations as well as the relations,

$\alpha_{Ki} = \gamma - \alpha_{Li} - \alpha_{M_i}$ and $\alpha_i^X = s_{Xi} = \frac{1}{\mu_i}\alpha_{Xi}$, the revenue function is re-written as follows[16],

$$r_i - \sum_{X \neq K} \bar{s}_{Xi}(x_i - k_i) = \tilde{r}_i = \gamma \frac{\overline{1}}{\mu_i} k_i + \frac{\overline{1}}{\mu_i}(\lambda_i + a_i) + \tilde{\varepsilon}_i \qquad \text{(A11)}$$

Equation (A11) is equation (1) in the section 2. As we mentioned, $\omega_i = (\lambda_i + a_i)$ is the firm specific quality adjusted productivity. That is, productivity means the efficiency to produce goods following valuation by consumers. $\check{\varepsilon}$ is added as the error term in estimation to consider measurement errors.

This productivity is different from the total factor productivity (TFP) by a factor share approach that is conventionally used in productivity analysis. The relation between ω_i and TFP is represented as follows,

$$TFP_i = \left(\overline{\frac{\gamma}{\mu_i}} - 1\right) k_i + \frac{\overline{1}}{\mu_i}\omega_i + \tilde{\varepsilon}_i \qquad \text{(A12).}$$

Equation (A12) shows that TFP includes the effect of the returns to scale $\left(\frac{\bar{\gamma}}{\mu_i} - 1\right)$, the markup effect $\frac{\bar{1}}{\mu_i}$, and the measurement errors $\tilde{\varepsilon}_i$.

Estimation Method

16 Klette (1999) and Martin (2008)

As we discussed, we apply a control function approach to estimate equation (A11) as well as various existing literature. First, ω_i is assumed to follow a Markov process. That is, $\omega_{it} = g(\omega_{it-1}, \underline{\omega}_{it-1}) + \nu_{it}$, and $\underline{\omega}$ is productivity at the threshold level for surviving. In a control function approach, the net revenue (Π: revenue – cost of adjustable variables) is used for approximation. Then, ω_i is estimated as follows,

$$\omega_{it} = \phi_{\omega}\left(k_{it}, k^{*}, \ln \prod_{it}, \ln \prod^{*}\right) \qquad \text{(A13)}$$[17].

Second, μ_i is determined by a function of inputs and the share of adjustable inputs as equation 2 shows. Here we rename equation 2 as equation (A14).

$$\frac{1}{\mu_i} = s_{xi}\left(\frac{\partial \ln F_i}{\partial \ln X_i}\right)^{-1} = s_{xi}\Psi(\mathrm{X}_i) \qquad \text{(A14)},$$

Following the proxy variable approaches such as Olly & Pakes (1996) and etc. Exit of firms is controlled by a probit regression,

$$P_{it} = P\left(\ln \mathrm{X}_{it-1},\ \ln \mathrm{X}^{*}_{t-1},\ s_{xit-1},\ s^{*}_{xt-1},\ \ln \Pi_{it-1},\ \ln \Pi^{*}_{t-1},\ t\right) \quad \text{(A15)}$$

Thus, equation (A12) is estimated as follows,

$$\tilde{r}_{it} = \phi_r\left(\ln \mathrm{X}_{it},\ \ln \mathrm{X}^{*}_{t},\ s_{xit},\ s^{*}_{xt},\ \ln \Pi_{it},\ \ln \Pi^{*}_{t}\right) \quad \text{(A15)}$$

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[17] The validity of the net revenue in a control function approach is well discussed in Martin (2008).

where $\phi_r(\cdot)$ is an unknown function and approximated by a polynomial. Using an estimate of ϕ_r, equation (A12) is represented as follows,

$$\tilde{r}_{it} - \tilde{\varepsilon}_{it} = \hat{\phi}_{rit} = \gamma \frac{\bar{1}}{\mu_{it}} k_{it} + \frac{\bar{1}}{\mu_{it}} \omega_{it} \qquad \text{(A16).}$$

From equation A16, the quality adjusted productivity is represented as follows,

$$\frac{\hat{\omega}_{it}}{\gamma} = \frac{\hat{\phi}_{rit}}{\frac{\gamma}{2}\left(s_{xit}\Psi(\ln \mathrm{X}_{it}) + s_t^*\Psi(\ln \mathrm{X}_t^*)\right)} - k_{it}$$

$$\text{s.t. } \frac{\bar{1}}{\mu_{it}} = \frac{1}{2}\left(s_{xit}\Psi(ln\mathrm{X}_{\mathrm{it}}) + s_t^*\Psi(ln\mathrm{X}_t^*)\right) \qquad \text{(A17).}$$

Since the functional form of $\Psi(\cdot)$ is unknown, the denominator of the first term in the right hand side of equation (A17) is denoted as follows,

$$\frac{\gamma}{2}\left(s_{xit}\Psi(ln\mathrm{X}_{it}) + s_t^*\Psi(ln\mathrm{X}_t^*)\right) = g_\mu(ln\mathrm{X}_{it}, ln\mathrm{X}_t^*, s_{xit}, s_t^*) \qquad \text{(A18).}$$

Now, equation (A17) is provisionally estimated as follows,

$$\frac{\hat{\omega}}{\gamma} = \frac{\hat{\phi}_{rit}}{g_\mu(ln\mathrm{X}_{it}, ln\mathrm{X}_t^*, s_{xit}, s_t^*)} \qquad \text{(A19).}$$

Using this provisional $\frac{\hat{\omega}}{\gamma}$, the assumption of Markov process gives us the following regression,

$$\frac{\hat{\omega}_{it}}{\gamma} = \left(\frac{\hat{\omega}_{it-1}}{\gamma}, \hat{P}_{it} \right) + v_{it} \qquad \text{(A20)},$$

where $\hat{P}_{it}$ is the predicted exit probability which is estimated at the first stage of this estimation procedure. Since the shock, ν_{it} is independent of all predetermined variables including capital, we can use the following moment restrictions to estimate remaining parameters,

$$E\left\{ \left[X_{it-1} \times k_{it} \right]' v_{it} \right\} = 0 \qquad \text{(A21)}.$$

Since γ is unknown, our estimtes of the firm-specific productivity and markup are obtained as follows,

productivity over homogeneous returns to scale across firms $= \frac{\omega_{it}}{\gamma}$ (A22),

the ratio between returns to scale and markup $= g_{\mu} = \frac{\gamma}{\mu_{it}}$ (A23).

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Table1. Number of Observations

	Domestic	Export	Export+FDI	No Export	Asia	NA	ROW	Asia+NA	Asia+ROW	NA+ROW	Global
Industry1	12635	973	160	12843	565	95	21	226	33	7	144
Industry2	4135	773	192	4434	546	26	11	163	35	3	157
Industry3	6033	680	100	6140	460	45	10	97	14	5	113
Industry4	3592	3053	664	3724	1314	148	16	906	167	8	1092
Industry5	6071	2391	450	6205	1534	90	21	607	86	10	451
Industry6	3603	967	154	3645	480	36	5	304	53	5	225
Industry7	12182	4109	603	12486	2457	303	32	1016	131	33	632
Industry8	6601	6043	1442	6812	2846	285	29	1864	290	20	2064
Industry9	2028	1767	368	2098	825	87	6	475	59	11	640
Industry10	8602	5007	1086	8834	2701	217	23	1732	132	10	188
Industry11	2324	1258	394	2388	585	107	2	385	37	8	491
Industry12	7681	3301	838	7851	1205	439	84	1139	168	15	998
Industry13	1628	1057	230	1675	477	57	12	261	47	4	398
Total	77295	31379	6681	79135	15595	1935	272	9175	1252	139	8593

Note: Industry1 = Foods and Beverages, Industry2 = Textile, Industry3 = Woods and Papers, Industry4 = Chemical Products, Industry5 = Plastic and Rubber Products, Industry6 = Glasses and Ceramics, Industry7 = Metals, Industry8 = General Purpose Machinery, Industry9 = Production Machinery, Industry10 = Electronic Parts, Devices & Electronic Circuits, Industry11 = Information and Communication Electronics, Industry12 = Transportation Equipment, Industry13 = Miscellaneous Products.

Table 2. Summary of Productivity and Markup Estimation

	N of Obs.	Productivity	Markup	Correlation
Industry1	13976	0.1340	1.0508	0.4735
Industry2	5399	-0.3786	1.0597	-0.4603
Industry3	6920	0.0613	1.1164	0.1172
Industry4	7441	-0.1080	1.1578	-0.0174
Industry5	9046	-0.0728	1.0878	-0.4086
Industry6	4766	0.3551	1.3356	-0.2745
Industry7	17198	0.2280	1.1328	0.0241
Industry8	14297	0.4601	1.1913	0.3284
Industry9	4233	0.0425	1.0534	-0.0761
Industry10	14927	-0.1409	1.2143	0.1522
Industry11	4040	-0.1262	0.9905	-0.7560
Industry12	11990	-0.0089	1.1044	-0.0242
Industry13	2962	-0.2051	1.0848	-0.6563

Note: Industry1 = Foods and Beverages, Industry2 = Textile, Industry3 = Woods and Papers, Industry4 = Chemical Products, Industry5 = Plastic and Rubber Products, Industry6 = Glasses and Ceramics, Industry7 = Metals, Industry8 = General Purpose Machinery, Industry9 = Production Machinery, Industry10 = Electronic Parts, Devices & Electronic Circuits, Industry11 = Information and Communication Electronics, Industry12 = Transportation Equipment, Industry13 = Miscellaneous Products.

Table 3. Estimation Results

variable	(1) productivity	(2) markup	(3) productivity	(4) markup
Export	0.010***	0.112***		
	(9.883)	(20.75)		
Export + FDI	0.107***	0.194***		
	(4.303)	(19.74)		
Asia			0.090***	0.056***
			(8.423)	(9.272)
NA			0.027	0.082***
			(1.042)	(6.234)
ROW			0.085	0.021
			(0.202)	(0.992)
ASIA+NA			0.125***	0.165***
			(7.282)	(19.59)
ASIA+ROW			0.152***	0.139***
			(4.810)	(8.683)
NA+ROW			-0.013	0.107*
			(-0.135)	(1.921)
Global			0.106***	0.260***
			(4.533)	(27.77)
Constant	-3.003***	3.292***	-2.986***	3.452***
	(-20.71)	(66.65)	(-20.37)	(66.75)
N. Obs	117195	117195	117195	117195
adj R^2	0.157	0.146	0.157	0.157

Note:*** denotes the 1 percent significance.

Figure 1. Distribution of Productivity

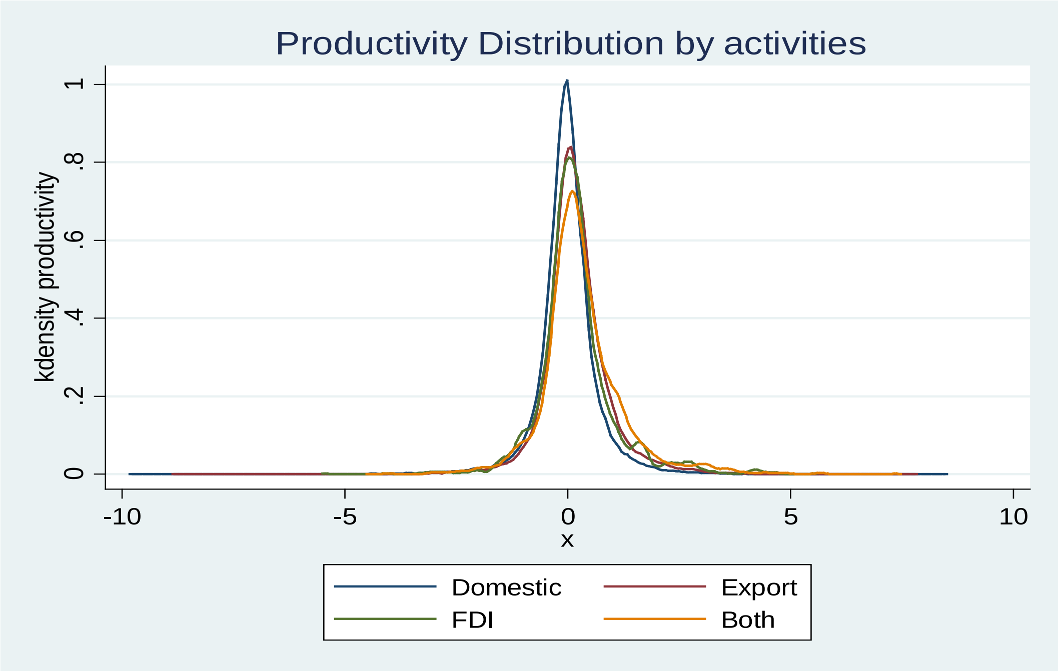

Figure 2. Distribution of Markup

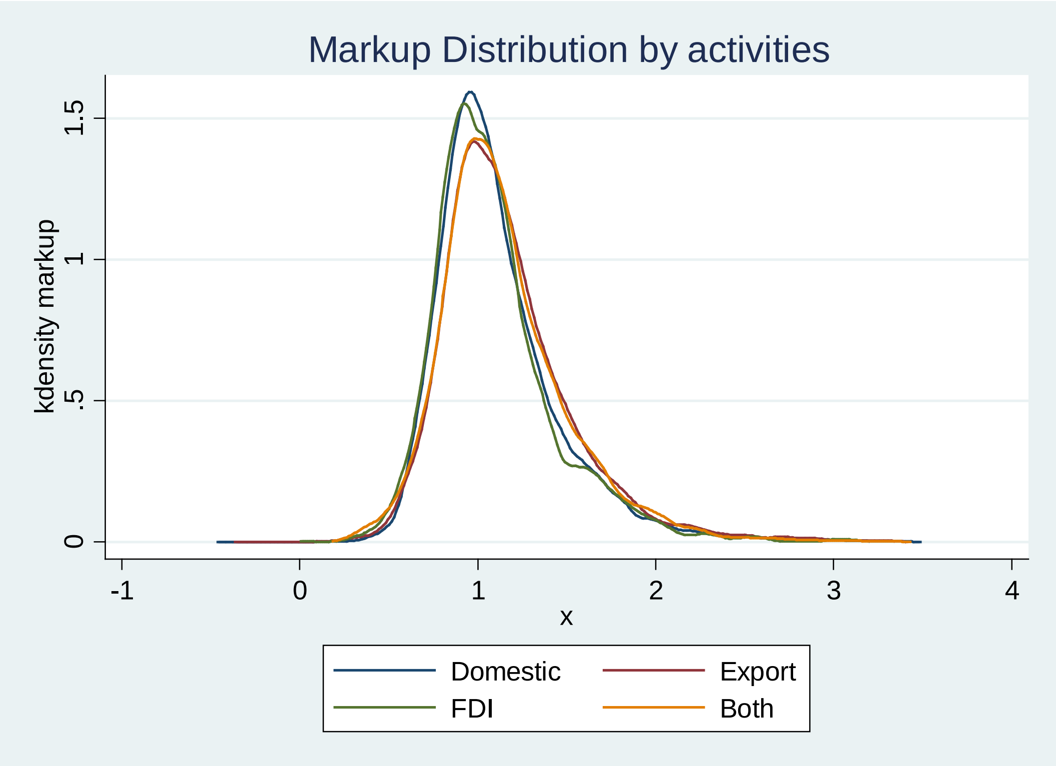

Figure 3. Distribution of Productivity by Market

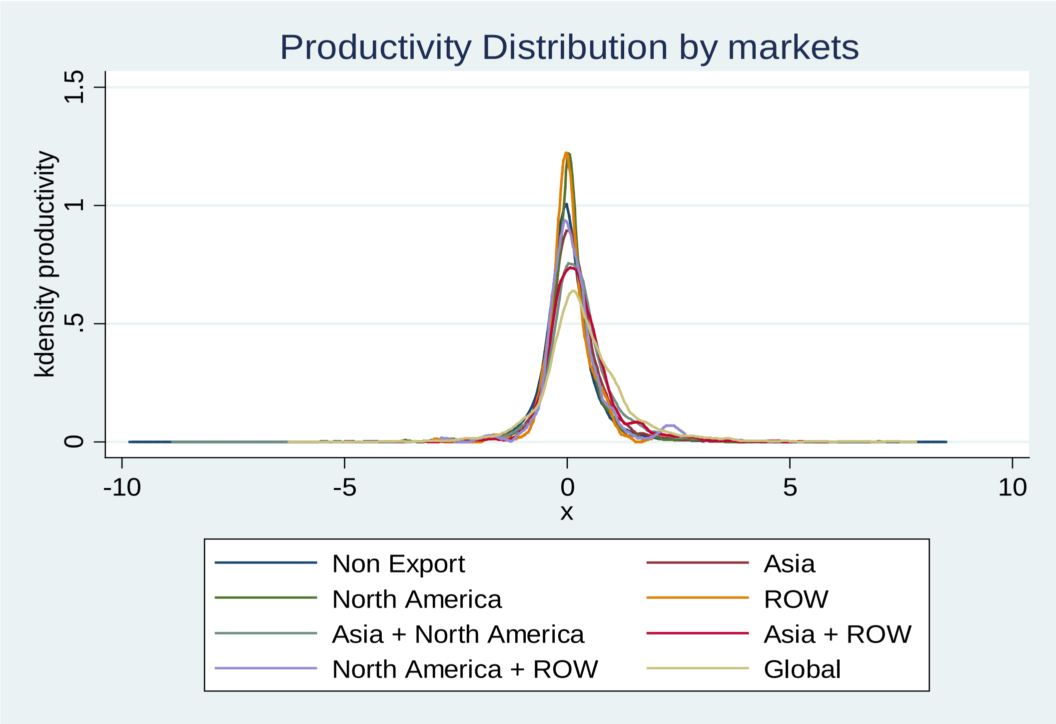

Figure 4. Distribution of Markup by Market