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A New Evidence for Exchange Rate Pass-through: Disaggregated Trade Data from Local Ports

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[Abstract]

For the estimation of exchange rate pass-through (henceforth ERPT), except for some evidence based on firm-level data, even the most disaggregated level of national export data is still biased with aggregation over sub-regions within an exporting country. We investigate to what extent this aggregation within product category is biased by comparing ERPT estimates across local ports. We use monthly exports at the HS 9-digit level from January 1988 to December 2005 for five major Japanese ports. Using a panel data regression framework, we control for exporting industry and importing country. Statistical tests provide strong evidence that export prices are set at different levels across local ports and that they correspond differently with respect to fluctuations of exchange rates.

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Keywords: Exchange rate pass-through; Firm heterogeneity; Japanese trade; Port-level trade; Pricing-to-market.

1. Introduction

Exchange rate pass-through (ERPT) measures the change in the price of traded goods corresponding to changes in the exchange rate. The empirical evidence for ERPT prior to the 1980s was based on aggregated data more focused on macroeconomic phenomena, such as domestic inflation. Since then, the seminal work by Dornbusch (1987) has suggested that several features of imperfect competition, namely the number of competitors, finite demand elasticity, and others, lead to incomplete pass-through. Krugman (1987), on the other hand, extrapolated the decades-old literature differently, suggesting that the same features affecting incomplete pass-through can explain the international price differentials arising from exchange rate fluctuations. This phenomenon has been termed "pricing-to-market." Enormous amounts of research, both theoretical and empirical, have since followed these studies[1].

More recent empirical evidence is provided with more disaggregated data to incorporate the microeconomic behavior of exporting firms. Takagi and Yoshida (2001) investigated the exchange rate pass-through of Japanese exports and imports to and from the Asian countries using HS (Harmonized Commodity Description and Coding System) 9-digit products, which constitute the most detailed international trade dataset of Japan. Gaulier et al. (2008) used the entire HS 6-digit product dataset and covered a broad range of exporting countries.

Some empirical research chooses to focus more on a particular market in order to emphasize the role of the exporting firms' price setting behaviors. Kadiyali (1997) used a structural econometric framework to study interacting effects of market structures and pricing

1 See Goldberg and Knetter (1997) for a survey.

strategies in the US photographic industry. Bernhofen and Xu (2000) examined the effect of market shares in an exporting market in the pass-through equation and found that German and Japanese firms exercised significant market power in the US petrochemical market.

However, apart from the occasional evidence based on firm-level data, even the most disaggregated level of HS trade data can still be suspected of aggregation bias within a category over exports of different firms, over differentiated products, and across local ports of the country. Although many researchers are well aware of this problem, no single empirical study has been carried out to investigate the bias of the most finely disaggregated datasets, such as the HS 9-digit code for Japan and the HS 10-digit code for the US, as this has been practically impossible. Our study attempts to address this problem.

In this paper, we disaggregate Japanese exports at the HS 9-digit level further than has been previously done by breaking up national trade into port-level trade[2]. We investigate the exchange rate pass-through of Japanese local-port international trade at the HS 9-digit level. The Ministry of Finance of Japan provided the trade statistics for each customs jurisdiction and international port[3]. We believe that investigations of port-level trade data at this disaggregation level are still few and far between, if they can be found at all, in the field of international economics.

Although there is growing evidence of heterogeneity in the exchange rate pass-through in terms of product categories, exporting countries, and importing countries (Knetter, 1993), it is still interesting to further investigate whether the exchange rate

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[2] Takagi and Yoshida (2001) investigate 11 Japanese HS 9-digit export products at national level while Parson and Sato (2008) cover for 27 export products.

[3] Because original datasets are dispersed over eight hundred files for each custom jurisdiction, we had to reconstruct the local port international trade dataset.

pass-through is homogeneous across local regions within an exporting country. We can expect to find heterogeneity in the exchange rate pass-through in local ports, even at the most disaggregated product level, if (1) competing companies choose different regions for their production of vertically differentiated products, or (2) a firm chooses to produce different quality models in different regions. In the empirical section, we formally test the null hypothesis of homogeneous pricing in Japanese ports. We find strong evidence that export prices are set at different levels in Japanese local ports and respond differently to exchange rate fluctuations, even when we control for the HS4 industries and importing countries.

We emphasize the importance of empirical evidence, as production locations within a country, in addition to quality and other factors already considered, are very important practical measures of product differentiations. In the remainder of this paper, we present a simple model in the next section, describe the dataset structure (Section 3) and provide evidence of the heterogeneity of ERPT behaviors in local Japanese ports (Section 4). Section 5 provides a robustness check on the estimation methodology and discusses the possible underlying structures that may cause ERPT differentials across the different ports. The final section summarizes our findings and sets a future research agenda.

2. The Model for Estimation

In this section, we present a simple model for an export price equation to estimate the exchange rate pass-through in a panel data model. We extend the empirical framework of the two-way fixed effect panel model used in Knetter (1989) and Takagi and Yoshida (2001). We pay particular attention to the estimated coefficients of local-port fixed effects, which may reflect a price differential due to heterogeneity among local ports.

Consider an exporting firm manufacturing product k located in region j within an exporting country[4]. After profit maximization, the exporter sets price (P_{ijkt}), in terms of exporter's currency, in a foreign country i on the basis of the demand conditions (D_{ijkt}), marginal cost (MC_{ijkt}) and the exchange rate (S_{it}), see Knetter (1989), Athukorala and Menon (1994), and Takagi and Yoshdia (2001).

$$P_{ijkt} = f(D_{ijkt}, MC_{ijkt}, S_{it}) \quad (1)$$

By restricting products to a narrowly defined industry, e.g., HS 4-digit industry, we assume that across-product variation in marginal cost is negligible. Therefore, marginal cost can be represented by time-variant regional specific marginal cost (MC_{ijt}), common for all products k. The demand conditions are assumed to be divided into three components: region specific demand condition (D_{ij}), product specific demand condition (D_{ik}), and time-variant demand condition for an industry (D_{it}). Note that there is no variation in (D_{ij}) if all exporters, regardless of regions, face the same demand conditions.

$$P_{ijkt} = f(D_{ij}, D_{ik}, D_{it}, MC_{ijt}, S_{it}) \quad (2)$$

By holding importing country fixed for a narrowly defined industry, the export price equation in log linear form is:

$$\ln P_{jkt} = \alpha_j + \alpha_k + \lambda_t + \beta \ln MC_{jt} + \gamma_j \ln S_t + \varepsilon_{jkt} \quad (3)$$

where the regional dummies α_j, the product dummies α_k, and time effect λ_t are assumed to reflect the demand conditions[5]. The export price P_{jkt} for a HS 9-digit product k from a regional port j is set in Japanese yen at time t. The exchange rate, S_t, is the value of the importing country's currency in Japanese yen. So γ_j represents exchange rate

[4] In this section we abuse the notation k to represent both regions and individual exporters.

[5] We should note that subscript i is deleted because importing country is fixed in each regression.

pass-through elasticity and is equal to zero for the case of *complete* pass-through. ε_{jkt} is a disturbance term.

If each exporter in different regions produces a type of variety in a manner assumed in a monopolistic competition model with constant elasticity of substitution for demand, price difference across regions becomes zero in equilibrium, i.e., the estimated coefficients of regional dummies α_j should be equal, or there are no idiosyncratic regional demand conditions. We can further expect the export price of each firm with respect to exchange rate fluctuations to respond in the same manner, i.e., regional specific exchange rate coefficients γ_j should be equal. On the other hand, regional dummies and exchange rate coefficients are expected to be different if each firm in different regions produces different quality products, as in the vertically differentiated product model in Flam and Helpman (1987).

2-1. Methodological issues

We frequently encounter cases in which the number of observations is extremely small for some triplets of (i, j, k) when disaggregated at the HS 9-digit level. In order to overcome this problem, we pool all HS 9-digit products for each of selected HS 4-digit industry in regression equations. Then, we estimate ERPT coefficients at the HS 4-digit level while we control for fixed effects at the HS 9-digit level[6]. By fixing an importing country and an HS 4-digit industry for each regression equation, the differences between local exporting ports are only possible causes for heterogeneity of pass-through coefficients.

[6] Gaulier et al. (2008) use a similar methodology to estimate pass-through coefficients at the HS 4-digit level while controlling for HS 6-digit level fixed effects.

For the given pair of an importing country and a HS 4-digit product group, we have the following export price equation (4),

$$\ln P_{jkt} = \alpha_{jk} + \alpha_m + \lambda_t + \beta \ln MC_{jt} + \gamma_j \ln S_t + \varepsilon_{jkt} . \tag{4}$$

where α_{jk} are multiplicative dummy variables[7] for a pair of region and product, and (monthly) seasonal dummies α_m are added to control for seasonality.

As a test of the heterogeneity of the exchange rate pass-through among local exporting ports, we investigate the null hypothesis of H_0: $\gamma_j = \gamma_{j'}$ for all $j, j' \in J$ in equation (4). We estimate the restricted coefficient regression in which all γ_j are equal and conduct an F-test using the residual sum of the squares from unrestricted equation (4) and restricted equation.

The exchange rate pass-through is affected by price-setting behaviors of exporting firms in response to exchange rate fluctuations. For example, an exporting firm can react differently from other firms to a change in exchange rate if faced with different demand elasticity. A rejection of the null hypothesis H_0 can, then, be interpreted as supporting evidence of differentiated products, in which an exporter can exercise some market power.

Although the exchange rate pass-through is a dynamic response of exporting firms, it is also important to investigate whether export prices are set at different levels among exporting local ports in Japan. We investigate to see whether the fixed effects for exporting local ports, α_i, are different at a statistically significant level in equation (5):

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[7] For example, there are only 15 dummies in equation (3) for five ports and ten products, whereas this specification requires 50 dummies.

$$\ln P_{ijkt} = \alpha_i + \alpha_j + \alpha_k + \alpha_m + \lambda_t + \beta \ln MC_{jt} + \gamma_j \ln S_{it} + \varepsilon_{ijkt} . \quad (5)$$

To test the heterogeneity of the fixed-effect coefficients among exporting local ports, we investigate the null hypothesis of $H_1: \alpha_j = \alpha_{j'}$ for all $j, j' \in J$ in equation (5). We estimate the restricted coefficient regression and conduct an F-test using the residual sum of the squares from the unrestricted equations and restricted equation.

3. Data

This paper investigates the exchange rate pass-through of Japanese exports at the level of the local ports by using datasets from the Ministry of Finance of Japan, which provides the trade statistics for each customs jurisdiction[8]. Due to the extremely large amount of data, datasets from each customs jurisdiction office were dispersed in over eight hundred files. We reconstructed the datasets from the original dispersed files.

3-1. Export unit price, exchange rate, and marginal cost

We use the monthly unit prices at the HS 9-digit level from January 1988 to December 2005 for goods exported from five major Japanese ports, Tokyo, Yokohama, Nagoya, Osaka, and Kobe, to six major importers of Japanese exports, China, Korea, Taiwan, Hong Kong, USA, and Germany. Fifty HS 4-digit product groups, presented in the

[8] A total of 209 customs offices, all under the Ministry of Finance, are situated near ports and airports engaged in international trade. The export declaration information required by the Customs Organization includes the Japanese *ports* of export, the country of destination, the value of the shipments expressed in Japanese yen, the date of export, and the 9-digit classification code of the exported goods, among other information.

Appendix, are selected in this study. In terms of HS 9-digit product level, there are a total of 815 products.

The unit prices are calculated as the value of the export divided by the number of units. When the number of units is not defined, the metric weight is used instead. Note that the export price is expressed in Japanese yen. The monthly average exchange rate is expressed as the value of the foreign currency in Japanese yen and is obtained from *International Financial Statistics*, IMF. Therefore, our definition of exchange rate pass-through elasticity takes the value of zero if the pass-through is *complete*, while a value of one corresponds to no pass-through at all.

It is noteworthy that the use of unit value export price as a proxy for actual export price is not without problems. Lipsey et al. (1991) point to inaccuracies of the unit values as measures of the prices of individual manufactured goods, especially when there is a significant quality change in the product. Some authors are keen to this unit value bias, and Athukorala and Menon (1994), for example, use genuine price indexes for Japanese export price. Unfortunately, export prices used in Athukorala and Menon (1994) are available neither at disaggregation at HS 9-digit product level nor at local ports used in our study.

A proxy for marginal cost variable MC_{jt} in equation (3) needs to be time-variant at monthly frequency and region-specific at the same time. We decided to use regional retail gasoline price as a proxy because it reflects well the movement of energy input as well as domestic transportation costs.

3-2. Data selection criteria

Disaggregated product trade data have one disadvantage: many of the datasets contain no data points in the categories of lightly traded products. In order to avoid selecting products with very few data points, we chose our samples of exporting regions, importing countries, and HS 4-digit product groups to be as large as possible using the following selection criteria. When selecting the exporting regions, we chose the five local ports with the highest trade activity. Table 1 shows that 40 to 60 percent of Japanese exports actually depart from Tokyo, Yokohama, Nagoya, Osaka, and Kobe. Although the fraction of goods exported from these ports declines gradually during the period of study, the cargo exported from these ports still represents a large portion of the total Japanese exports.

As for the importing countries, we chose the six countries having engaged in the largest amounts of trade with Japan between 1988 and 2005. These countries are the US, China, Taiwan, Korea, Hong Kong, and Germany. We intentionally set our selection criteria so that at least one European country would be included in our sample. The Japanese goods exported to these six countries makes up about 60 percent of the total Japanese exports.

The HS 4-digit product groups were chosen by identifying the 50 most exported products[9], as shown in the Appendix. We added to our list the 51st and 52nd most exported products because two product categories, re-export [0000] and ships and vessels [8901], were excluded from the original list. The HS 4-digit code [0000] covers entire products, and [8901] contains only a small number of observations (only 129 data points).

The sum of export values of the top fifty HS 4-digit product groups from 1988 to 2005 is quite representative of the overall exports. Their relative shares are similar to the figures in Table 1: Tokyo (50 trillion yen), Yokohama (68 trillion yen), Nagoya (71 trillion

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[9] The 50 most traded HS 4-digit code products make up 65 percent, the top 100 HS4 products make up 78 percent, the top 200 HS4 products account for 90 percent, and the top 300 HS4 products make up 95 percent of the total Japanese exports.

yen), Osaka (16 trillion yen), and Kobe (35 trillion yen).

4. Estimation results

4-1. Testing homogeneous ERPT coefficients among exporting ports

Panel regression is separately performed for each HS 4-digit industry for each importing country, using equation (4). Table 3 shows the estimated coefficients for γ_j for exports to Korea[10]. The first number in square brackets shows the ranking by value among all Japanese exports from 1988 to 2005. A description of the HS 4-digit code in the second column can be found in the Appendix. The third through seventh columns show the estimated exchange rate pass-through coefficients of five exporting ports. An asterisk (*) indicates, for the case of excessive pass-through, an estimated coefficient less than zero with statistical significance. In the case of excessive pass-through, the foreign price of Japanese exports is raised proportionately more than the appreciation of the yen. A sharp (#) indicates that the estimated coefficient is greater than unity with statistical significance. This is called perverse pass-through by Froot and Klemperer (1989). For the coefficients without an asterisk or sharp, the null of exchange rate pass-through between zero and one cannot be rejected. The next two columns provide information about the fitness of regression and the number of observations for each HS 4-digit group. The third from the last column provides the F statistics used to test the null hypothesis of equal ER pass-through coefficients across five exporting ports. LM and DW in the last two columns are the test statistics for the null of homoskedastic and no autocorrelation for disturbances. As both LM

[10] Tables for the estimated exchange rate pass-through for other importing countries are available upon request to the author.

and DW indicate the pervasive presence of non-spherical disturbances, we calculated heteroskedasticity robust standard errors.

Among 300 ER pass-through regressions (fifty HS 4-digit groups for six importing countries), at a statistical significance level of one percent, almost 80 percent of the observations reject the null hypothesis of the equality of ER pass-through coefficients among Japanese exporting ports[11]. This pervasive rejection of the hypothesis of equal ER pass-through coefficients indicates that Japanese export products demonstrate quite different price responsiveness with respect to exchange rate fluctuations among exporting ports, even when we control for absolute price differences in importing countries, industries, and exporting ports[12].

Since we have 1,500 estimated coefficients[13], it is very difficult to summarize the results by looking at all the tables. We therefore provide a summary in Table 4 and kernel density estimation of the ER pass-through in Figure 1 and Table 6.

4-2. Distributional characteristics of local port ERPT

The estimated exchange rate pass-through coefficients are summarized for exporting

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[11] At a level of one percent statistical significance, 240 out of 300 reject the null hypothesis, while 268 out of 300 reject the null at a level of ten percent statistical significance.

[12] We need to interpret the test result with caution when disturbance term variance is not homoskedastic. The actual probability of a type I error of F test may be smaller when the disturbance term is non-spherical. However, the magnitude of F statistics for many cases are much larger than critical values of one percent significance level.

[13] 50 HS 4-digit groups, five exporting local ports, and six importing countries.

local ports in Figure 1 and Table 6. We observe a stark difference in the mean ERPT among these local ports in Table 6, and they can be classified into high ERPT ports (Tokyo), middle ERPT ports (Yokohama, Nagoya, Kobe), and low ERPT ports (Osaka). Lower degree of ERPT for Osaka port is persistent when we compare the average ERPT in Table 4. The degree of ERPT (estimated coefficients) in Osaka port is lowest (highest) for any destination countries, except for China.

The magnitude of the variance is also different among the five ports: Osaka demonstrates a substantially larger variance compared to the other ports. The kernel density distributions are skewed toward zero, corresponding to a complete pass-through. The higher value of kurtosis for Osaka also reveals that Osaka has a fatter tail. It is also noteworthy that ERPT of US is lowest among destination countries, consistent with the findings in Parsons and Sato (2008).

4-3. Price Differentials among Local Ports

In previous subsections, we showed evidence of heterogeneity among local ports in terms of the exchange rate pass-through. In this subsection, we also investigate heterogeneity of local port exports simply by comparing local-port fixed effects in equation (5). Table 5 shows tests of equality coefficients among local-port fixed effects[14]. We should also note that the export price is expressed in logarithmic form, so that a difference of 0.693 implies a two-fold difference in nominal price. The F-test in Table 5 shows that there are large discrepancies in logarithmic export prices among exporting local ports. We therefore conclude that export prices, even at the disaggregated level of HS 9-digit products,

[14] Due to the space constraint, we suppressed the estimated coefficients of port fixed effects; however, these are available upon request to the author.

are set differently across Japanese local ports.

5. Robustness Check and Discussions

The Durbin-Watson statistics in Table 3 indicate that the regressions suffer from serial correlations. We, therefore, repeated entire regressions with first-differenced variables. Although the fitness of the regressions in terms of adjusted R-squared significantly declined, the DW statistics show that there are no longer serial autocorrelation problems in regressions. The tests in many cases failed to reject the null hypothesis of homogeneous coefficients for regional exchange rate pass-through. In almost half of 300 industry-country pairs, however, the tests still reject the null hypothesis of similar price responsiveness of regions to exchange rate changes. So we can be assured that our conclusion is robust to empirical specifications.

The empirical results presented in the last section support the assertion that prices of export products across Japanese local ports respond differently to exchange rate fluctuations. In this section, we discuss the possible underlying causes, which may have influenced these differences in ERPT across these local ports. We will consider the following issues: (1) industry specialization of ports, (2) HS9 product specialization within HS4 industry, and (3) differentiated quality and hedonic pricing.

We should note that observed heterogeneous price responsiveness might arise from the difference in industry structures of each region. Some ports may be located in regions specializing only in a subset of our sample industries. For a given industry, the dominant region may be able to choose a different pricing strategy. Investigations of each port's relative share of exports in each HS 4-digit product group show that all five ports seem to engage substantially in exports of all product groups. Except for several cases of automobile-related and steel products, most of the product groups are not dominated by any one region[15]. We may therefore conclude that industry-specialization patterns of ports can be minor source at most for heterogeneous ERPT behaviors among ports.

The problem of port specialization in the HS9 product category within the HS4 industry still remains. For a given HS4 industry, the differences in ERPT may only be picking up the ERPT of different HS9 products if each port specializes in the specific HS9 product within the HS4 industry. We can investigate whether or not this is the case indirectly by focusing on the HS4 industries consisting of only a single or a few products. For these HS4 industries, the HS9 specialization effect should be small or nonexistent. The printed circuits category [8534] consists of only a single product, and the null hypothesis of the homogeneous ERPT is rejected for all six importing countries. For video recorders [8521] and switch boards [8537], there are only two HS9 products within HS4, and the null hypothesis of the homogeneous ERPT is rejected for 11 cases out of 12. Therefore, other factors seem to be present and causing the differences in ERPT among ports, while the HS9 specialization effect may still be important.

Even within the HS9 product, export products of each port may still be differentiated from each other. The F tests in Table 5 provide evidence that products from different ports are priced differently at level, even when controlling for importing countries and HS9 products with fixed effects. These price differences among ports, with control for the HS9 product, can be interpreted as evidences for differing quality of similar products or vertically

[15] The exceptions are automobiles [8703], cold flat-rolled steel [7209], and flat-rolled alloy steel [7225], in which Nagoya dominates with 84, 72, and 68 percent, respectively. In other cases, Kobe dominates motorcycle exports [8711] with 64 percent, while 66 percent of trucks [8704] are exported from Yokohama.

differentiated products (Flam and Helpman, 1987) or for reflection of the different compositions of several attributes, as in the hedonic pricing model (Rosen, 1974). In our framework, manufacturing plants producing products of varying quality or different composition of attributes are located in distinct regions (ports).

6. Conclusion

Recent empirical studies examining the exchange rate pass-through are more inclined to investigate finely disaggregated products. These studies show substantial evidence pointing to heterogeneity of exchange rate pass-through among exporting countries, importing countries, and industry/products. To add another parameter influencing the heterogeneity of exchange rate pass-through, we investigated a dataset for international trade of local regions within a country.

Our empirical evidence strongly supports that export prices are set differently among Japanese local ports and that price responsiveness with respect to a change in exchange rate also differs across Japanese local ports, even when sample products are restricted to single disaggregated industry group (HS4) and the finest product fixed-effects (HS9) are controlled for. We interpret this empirical result as evidence for (1) different firms choosing different regions for their (vertically) differentiated products and/or (2) a firm possibly choosing different regions for different quality models. These behaviors of firms would not be surprising, but it is striking that they can be persistently confirmed with empirical regressions.

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Appendix. Selected HS 4-digit industries

HS4 code	code description	rank	share
4011	New pneumatic tires, of rubber	[20]	0.8%
7208	Flat-rolld products of iron/non-al/s wdth>/=600mm, hr, not clad, pltd	[30]	0.5%
7209	Flat-rolld prod of iron/non-alloy steel wd>/=600mm, cr, nt clad, pltd	[38]	0.4%
7210	Flat-rolled prod of iron or non-al/s wd>/=600mm, clad, plated or coat	[28]	0.6%
7225	Flat-rolled products of other alloy steel, of a width of 600mm or mor	[47]	0.4%
7304	Tubes, pipes and hollow profiles, seamless, or iron or steel	[35]	0.5%
8407	Spark-ignition reciprocating or rotary int combu piston eng	[11]	1.1%
8408	Compression-ignition int combu piston eng (diesel or semi-diesel eng)	[37]	0.5%
8409	Part for use solely/principally with the eng of hd no84.07/84.08	[14]	1.0%
8413	Pumps for liquids, w/n fitted with a measuring device; liquid elevato	[36]	0.5%
8414	Air/vacuum pumps/air/o gas comp & fans; hoods incorp a fan, w/n w fi	[21]	0.8%
8429	Self-propelld bulldozer/angledozer/ grader/excavator/shovel loader, e	[17]	0.9%
8471	Automatic data proces mach; optical reader, mach for transcribg data,	[04]	3.4%
8473	Parts & acces o/t cover/carryg cases & sim for use with hd 84.69-84.7	[05]	2.7%
8477	Machinery for wrkg rbr/plas/for the mfr of prod from these material n	[45]	0.4%
8479	Machines & mech appl having indiv func, nes or included in this chapt	[08]	1.7%
8481	Tap, cock, valve for pipe, tank for the like, incl pressure reducing	[40]	0.4%
8482	Ball or roller bearings	[33]	0.5%
8483	Transmission shafts & cranks, bearing housing; gearing; ball screws;	[26]	0.6%
8501	Electric motors and generators (excluding generating sets)	[43]	0.4%
8504	Electric transformer, static converter (for example rectifiers) & ind	[31]	0.5%
8507	Electric accumulatr, incl separatr therefr, w/n rectanglr (incl squar	[32]	0.5%
8511	Electrical ignition/starting equip, ex spark plugs/starter motors, et	[50]	0.4%
8517	Electric app for line telephony/line telegraphy, incl curr line syste	[12]	1.0%
8521	Video recording or reproducing apparatus	[19]	0.8%
8522	Parts and accessories of apparatus of heading nos 85.19 to 85.21	[39]	0.4%
8523	Prepard unrecordd media for sound record/sim record, o/t prod of ch 3	[25]	0.6%
8525	Transmissn app for radio-telephony radio-broadcastg; television camer	[06]	2.0%
8527	Reception app for radio-telephony/radio-broadcastg w/n combi w a cloc	[34]	0.5%
8528	Television receivers (incl video monitors & video projectors)	[22]	0.7%
8529	Part suitable for use solely/princ with the app of headg no85.25-85.2	[18]	0.9%
8532	Electrical capacitors, fixed, variable or adjustable (pre-set)	[23]	0.7%
8534	Printed circuits	[49]	0.4%
8536	Electrical app for switchg (ex fuse, switche, etc) nt exceedg 1000 vo	[15]	0.9%
8537	Board, panels & o bases, equipped w two/more app of hd no 85.35/85.3	[44]	0.4%
8540	Thermionic, cold cathode valves & tube (ex vac/ga filld, tv camera tu	[16]	0.9%
8541	Diodes/transistors & sim semiconductor devices; light emitting diodes	[09]	1.3%
8542	Electronic integrated circuits and microassemblies	[02]	4.8%
8543	Electrical mach & app having individual function, nes/incl in thi cha	[24]	0.6%
8544	Insulated wire/cable & o insul elec conductors w/n fitted w connector	[46]	0.4%
8703	Motor veh princ designd for transp person (o/t 8702) incl car/sta wag	[01]	13.0%
8704	Motor vehicles for the transport of goods	[07]	1.9%
8708	Parts & access of the motor vehicles of heading nos 87.01 to 87.05	[03]	3.8%
8711	Motorcycles & cycles w auxiliary motor, w or w/o side-cars; side-cars	[13]	1.0%
9001	optical fibre, cables; sheets & plate of polarizing mat; lenses/prism	[48]	0.4%
9009	Photo-copyg app incorp an optical sy/of the contact type & thermo-cop	[10]	1.1%
9010	Apparatus & equip for photographic laboratories nes	[29]	0.6%
9018	Instrument & appl usd in vet/med/surg/ dental, other electro-medicl a	[27]	0.6%
9030	oscilloscope/spectrum analysers & other inst; inst & app for mea ioni	[42]	0.4%
9504	Articles for funfair, table/parlor games & auto bowling alley equipt	[41]	0.4%

Note: The largest 52 HS 4-digit categories are selected. The '0000' (re-export) is excluded from the sample because this category contains the mix of various products. The '8901' (ships and vessels) is also not used due to the small number of observaitons. Code definitions are by OECD International Trade by Commodity Statistics

Table 1: Share of Exports for Five Major Japanese Local Ports

(billion yen)	1988	1992	1996	2000	2004
Japan	33,986	43,137	44,887	51,848	61,333
Tokyo	12.4%	11.8%	9.9%	8.7%	7.2%
Yokohama	17.4%	16.9%	15.8%	11.8%	11.3%
Nagoya	11.3%	12.5%	13.5%	12.4%	13.4%
Osaka	5.4%	4.7%	4.5%	3.1%	3.3%
Kobe	12.5%	13.0%	9.2%	8.0%	7.9%
Five ports total	59.1%	58.8%	52.9%	44.0%	43.1%

Table 2: Major Trading partners with Japanese Exports

(billion yen)	1988		1992		1996		2000		2004	
World	33,986		43,137		44,887		51,848		61,333	
USA	11,500	(0.34)	12,147	(0.28)	12,210	(0.27)	15,388	(0.30)	13,762	(0.22)
China	1,220	(0.04)	1,518	(0.04)	2,394	(0.05)	3,297	(0.06)	8,003	(0.13)
Taiwan	1,858	(0.05)	2,700	(0.06)	2,838	(0.06)	3,896	(0.08)	4,570	(0.07)
Korea	1,992	(0.06)	2,268	(0.05)	3,205	(0.07)	3,327	(0.06)	4,805	(0.08)
Hong Kong	1,507	(0.04)	2,638	(0.06)	2,769	(0.06)	2,939	(0.06)	3,838	(0.06)
Germany	2,025	(0.06)	2,581	(0.06)	1,985	(0.04)	2,160	(0.04)	2,053	(0.03)

Note: The first figures indicate the Japanese export value in billion yen and the second figures in parenthesis represent the trading-partner country's share of the Japanese export in the world.

Table 3: Estimated exchange rate pass-through coefficients for Korea

	HS4	Tokyo	Yokohama	Osaka	Kobe	Nagoya	Adj R2	NOB	F Stat	LM	DW
[01]	8703	0.427	0.205	1.313	0.386	0.555	0.68	1512	2.1 *	1.66	1.6
[02]	8542	1.211	0.352	0.121	0.544	-0.005	0.87	9626	23.0 ***	12.9 ***	1.2
[03]	8708	0.306	0.444	0.357	0.434	-0.222	0.44	8580	23.1 ***	294 ***	1
[04]	8471	0.473	0.141	0.842	-0.464	-0.173	0.61	8082	5.5 ***	349 ***	1.3
[05]	8473	-0.109	0.458	0.315	-0.369	0.906	0.22	2861	9.9 ***	63.5 ***	1.3
[06]	8525	0.270	-0.296	-0.014	0.777	0.071	0.46	3070	13.3 ***	104 ***	1.5
[07]	8704	-2.378	-0.440	-0.582	-2.038 *	-1.285	0.73	365	0.8	0.71	1.9
[08]	8479	0.597	0.377	0.313	0.235	0.242	0.86	4817	2.2 *	10.2 ***	1.7
[09]	8541	0.176	-0.545	-0.166	-1.448 *	0.005	0.73	11071	30.2 ***	187 ***	1
[10]	9009	0.354	-0.492	0.121	1.925 ##	-0.210	0.35	2469	32.4 ***	13.3 ***	1.2
[11]	8407	0.532	0.752	0.484	0.162	-0.082	0.37	1582	8.0 ***	0.78	1.5
[12]	8517	0.829	1.155	2.737	0.107	2.001	0.62	1771	5.7 ***	145 ***	1.2
[13]	8711	2.169 ##	1.694 #	0.607	1.024	0.875	0.79	1466	15.5 ***	79.9 ***	1.6
[14]	8409	-0.472	-0.352	0.932	-0.700 *	-0.123	0.36	4062	31.3 ***	1.09	1.3
[15]	8536	0.223	0.189	0.086	0.122	0.378	0.31	9219	2.8 **	233 ***	1.2
[16]	8540	0.244	0.112	1.137	0.876	0.222	0.74	4025	17.3 ***	38.4 ***	0.9
[17]	8429	-1.567	-0.462 *	0.511	-0.093	0.733	0.66	1367	8.1 ***	0.56	1.8
[18]	8529	-0.726	0.701	0.030	0.217	0.148	0.52	2630	19.9 ***	1.77	1.1
[19]	8521	0.060	-0.346	-0.220	0.860	0.207	0.27	782	2.1 *	16.8 ***	1.5
[20]	4011	-0.666	0.597	-0.365	0.257	-0.258	0.65	1377	19.5 ***	3.22 *	1.6
[21]	8414	-0.095	0.037	0.306	0.180	-0.198	0.43	7728	7.3 ***	135 ***	1.5
[22]	8528	0.079	1.271	-0.813	1.079	0.691	0.33	1783	4.4 ***	40.6 ***	1.4
[23]	8532	-0.895	0.723	0.013	1.176	-0.084	0.32	6169	45.0 ***	1.77	0.8
[24]	8543	0.334	-0.421	-0.566	-0.158	2.307 #	0.54	2807	18.4 ***	77.4 ***	1
[25]	8523	1.209	-0.063	0.407	0.349	1.247	0.58	3143	11.1 ***	92 ***	1.2
[26]	8483	0.548	0.505	0.955	0.793	0.020	0.28	11572	36.4 ***	309 ***	1.4
[27]	9018	0.425	-0.202	-0.059	0.086	-0.504	0.78	5837	11.9 ***	7.68 ***	1.4
[28]	7210	-0.327	-0.584	0.852	0.171	0.668	0.97	2352	30.2 ***	4.03 **	1.2
[29]	9010	-0.597	-0.280	1.027	-0.301	-0.167	0.83	2109	5.4 ***	4.12 **	1
[30]	7208	1.098	0.293	0.511	0.426	0.014	0.99	3029	3.7 ***	2.81 *	1.6
[31]	8504	0.122	0.776	0.459	0.137	0.005	0.36	7872	13.3 ***	0.07	1.3
[32]	8507	0.969	0.214	0.671	-0.151	0.332	0.58	2676	8.1 ***	0.97	1.3
[33]	8482	1.115	0.068	0.145	0.155	-0.565 **	0.62	7147	65.9 ***	473 ***	1.3
[34]	8527	-0.047	0.375	1.792	0.164	0.557	0.69	2504	5.2 ***	0.1	0.9
[35]	7304	0.312	0.206	0.290	0.085	0.180	0.94	4983	0.6	2.16	0.9
[36]	8413	0.284	0.077	0.140	0.163	-0.531 *	0.36	9109	34.6 ***	200 ***	1.5
[37]	8408	-0.567 *	-0.400	0.021	1.319	-0.879 **	0.47	2407	57.0 ***	70.3 ***	1.3
[38]	7209	0.660	0.850	0.672	1.137	0.505	0.99	2221	1.5	11.1 ***	1.6
[39]	8522	-0.902 *	-1.312 **	0.784	0.578	-1.591 **	0.53	1170	24.2 ***	42.9 ***	1.3
[40]	8481	-0.067	-0.003	0.094	0.048	-0.436	0.35	9588	23.1 ***	143 ***	1.3
[41]	9504	-0.740	0.943	-0.395	-1.271	2.109 #	0.30	1678	16.9 ***	7.4 ***	1.2
[42]	9030	-0.533	-0.561	0.525	-0.703 **	-0.092	0.67	4913	14.8 ***	107 ***	1.6
[43]	8501	-0.081	0.074	-0.118	0.731	-0.116	0.32	11360	29.5 ***	29.2 ***	1.4
[44]	8537	-0.497 *	-0.329	0.156	0.104	-0.441	0.13	1367	5.5 ***	10.6 ***	1.6
[45]	8477	0.140	1.158	2.208 ##	0.612	1.305	0.35	3687	18.6 ***	15.2 ***	1.7
[46]	8544	-0.085	-0.186	-0.056	-0.240	0.037	0.44	8019	1.6	121 ***	1.4
[47]	7225	1.855	0.842	0.438	1.335	1.868	0.94	2043	11.6 ***	42.3 ***	0.7
[48]	9001	1.419	0.376	0.842	1.118	1.861	0.69	1815	6.5 ***	18.4 ***	1.2
[49]	8534	-0.291	0.487	-0.284	-0.625	-1.726 **	0.38	995	21.1 ***	0.02	1.2
[50]	8511	-0.165	0.252	0.170	-0.042	0.094	0.49	3919	2.4 **	23.7 ***	1.3

Note: One-side test of coefficient being greater than zero (or less than unity) with statistical significance at one percent and ten percent level are shown respectively by ** and * (or by ## and #). The figures in the F stat indicate the F statistics for testing the null hypothesis of equal ER pass-through coefficients across exporting ports. LM is the test for the null of homoskedastic disturbances and DW is the Durbin-Watson statistics for unbalanced panel.

Table 4. Summary of estimated exchange rate pass-through

	Tokyo			Yokohama			Osaka			Kobe			Nagoya		
	Excess	Normal	Perv	Excess	Normal	Perv	Excess	Normal	Perv	Excess	Normal	Perv	Excess	Normal	Perv
Korea	6%	92%	2%	4%	94%	2%	0%	98%	2%	8%	90%	2%	10%	86%	4%
		0.14 (0.13)			0.20 (0.19)			0.36 (0.39)			0.32 (0.23)			0.26 (0.21)	
China	6%	92%	2%	0%	98%	2%	2%	94%	4%	0%	96%	4%	10%	88%	2%
		0.41 (0.33)			0.42 (0.46)			0.53 (0.60)			0.59 (0.63)			0.23 (0.18)	
Taiwan	14%	82%	4%	2%	94%	4%	0%	94%	6%	8%	90%	2%	6%	86%	8%
		0.32 (0.15)			0.37 (0.46)			0.64 (0.77)			0.45 (0.39)			0.53 (0.73)	
Hong Kong	16%	82%	2%	0%	96%	4%	10%	84%	6%	4%	94%	2%	14%	82%	4%
		0.31 (0.01)			0.36 (0.43)			0.58 (0.50)			0.30 (0.26)			0.21 (0.13)	
Germany	0%	98%	2%	4%	92%	4%	2%	90%	8%	6%	94%	0%	2%	94%	4%
		0.40 (0.44)			0.34 (0.25)			0.60 (1.57)			0.27 (0.17)			0.54 (-0.14)	
USA	2%	98%	0%	2%	94%	4%	4%	90%	6%	0%	94%	6%	0%	94%	6%
		0.73 (0.61)			0.67 (0.63)			0.89 (0.91)			0.56 (0.63)			0.57 (0.64)	

Note: "Perverse" is defined as ERPT coefficients greater than unity with statistical significance while "Excessive" is defined as ERPT coefficients less than zero with statistical significance. The figure (in parenthesis) below is the average of ERPT coefficients for "Normal" (for entire sample).

Table 5: Test for equal coefficients among port fixed effects

	HS4	NOB	HS9	F Stat		LM			HS4	NOB	HS9	F Stat		LM	
[01]	8703	17,279	20	71.3	***	282	***	[26]	8483	67,643	15	258.2	***	104.2	***
[02]	8542	54,723	35	111.0	***	309	***	[27]	9018	41,720	24	78.9	***	1496.2	***
[03]	8708	70,530	17	521.7	***	2269	***	[28]	7210	18,388	22	348.9	***	94.7	***
[04]	8471	58,223	29	44.6	***	2630	***	[29]	9010	11,494	9	44.4	***	29.4	***
[05]	8473	18,812	6	84.6	***	165	***	[30]	7208	9,778	69	277.2	***	0.2	
[06]	8525	29,030	17	21.7	***	159	***	[31]	8504	48,468	25	151.2	***	56.9	***
[07]	8704	9,381	18	3.7	***	157	***	[32]	8507	22,183	9	37.6	***	8.4	***
[08]	8479	26,353	11	153.2	***	53.2	***	[33]	8482	41,151	9	,615.1	***	943.8	***
[09]	8541	63,762	20	126.4	***	1626	***	[34]	8527	24,485	19	57.6	***	861.2	***
[10]	9009	16,306	10	91.7	***	764	***	[35]	7304	17,037	26	178.0	***	46.2	***
[11]	8407	15,091	14	77.1	***	48.5	***	[36]	8413	49,950	18	384.5	***	244.7	***
[12]	8517	22,850	21	32.1	***	2626	***	[37]	8408	17,553	9	258.3	***	23.3	***
[13]	8711	11,454	14	8.4	***	519	***	[38]	7209	13,921	41	492.6	***	76.3	***
[14]	8409	26,099	7	127.0	***	377	***	[39]	8522	8,502	3	83.1	***	44.1	***
[15]	8536	58,939	15	136.6	***	597	***	[40]	8481	52,421	10	203.2	***	119.1	***
[16]	8540	24,889	22	25.6	***	14.6	***	[41]	9504	12,077	6	70.1	***	274.1	***
[17]	8429	15,332	13	14.7	***	1.37		[42]	9030	31,025	12	89.1	***	1212.9	***
[18]	8529	19,515	7	73.0	***	205	***	[43]	8501	63,430	27	122.2	***	81.9	***
[19]	8521	8,095	2	66.7	***	7.59	***	[44]	8537	7,843	2	24.8	***	42.7	***
[20]	4011	16,087	14	67.5	***	302	***	[45]	8477	20,609	10	58.4	***	491.9	***
[21]	8414	47,305	16	75.8	***	598	***	[46]	8544	59,567	29	106.4	***	617.5	***
[22]	8528	18,563	15	2.4	**	234	***	[47]	7225	6,724	23	119.7	***	0.0	
[23]	8532	38,293	10	10.3	***	22.5	***	[48]	9001	13,223	7	128.8	***	47.9	***
[24]	8543	16,385	10	93.3	***	1273	***	[49]	8534	6,103	1	n.a		47.9	***
[25]	8523	23,363	14	62.1	***	1437	***	[50]	8511	35,937	13	47.1	***	0.1	

Note: Statistical significance at one percent, five percent, and ten percent level is shown respectively by ***, **, and *. The figures in the F stat indicate the F statistics for testing the null hypothesis of equal fixed-effect coefficients across exporting ports. HS9 indicates the number of HS 9-digit products within the industry.

Table 6. Summary Statistics for Kernel Density Estimation by Exporting Ports

	peak	mean	variance	skewness	kurtosis
Tokyo	0.50	0.30	0.089	-0.027	0.0079
Yokohama	0.40	0.40	0.155	-0.061	0.0240
Nagoya	0.15	0.40	0.154	-0.060	0.0236
Osaka	0.35	0.65	0.407	-0.259	0.1655
Kobe	0.20	0.38	0.142	-0.054	0.0202

Note: Kernel densityis estimated for each importing country from 300 estimated ER pass-through coefficients with Gaussian kernel and band width of 0.15. The Kernel density is estimated every 0.05 points in [-6, 6]. To calculate the moments of estimated distribution function, only the interval [-6,6] is used.

Figure 1. Kernel Density Estimation of (HS4) ER Pass-through by Exporting Ports