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Is Exchange Rate Pass-Through Declining?
Evidence from Japanese Exports to USA and Asia[1]

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Abstract

Unlike the previous studies, this paper reexamines the degree of exchange rate pass-through (henceforth ERPT) in Japanese exports to the USA and Asian countries by using the destination breakdown data of 300 export commodities at the HS 9-digit level. By conducting the fixed effect panel estimation, we have found that ERPT has increased in Japanese exports to all destinations, even to the USA, at the HS 4-digit commodity level, which contrasts markedly with the Taylor's (2000) conjecture that ERPT declined in the low inflation environment.

Key words: exchange rate pass-through, pricing-to-market, Japanese exports, East Asia.
JEL Classification: F23, F31

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1. INTRODUCTION

The exchange rate pass-through (henceforth ERPT) has gained renewed attention in recent years in both theoretical and empirical literature. Taylor (2000) conjectured that the extent of ERPT declined in the low inflation environment. Recent studies, such as Campa and Goldberg (2005) and Otani, Shiratsuka and Shirota (2005), have examined the degree of ERPT in import prices using either the data on a number of source countries or the industry/commodity breakdown data. In contrast to the previous studies, this paper employs the data on Japanese exports by commodity and by destination country to make more rigorous empirical investigation about whether the degree of ERPT has declined in the case of Japanese exports.

The highly disaggregated commodity data by destination is often used in the literature such as Knetter (1989), Takagi and Yoshida (2001), Sato (2003), Parsons and Sato (2008) and Yoshida (2009). However, except for Yoshida (2009), the above studies tend to choose only a small number of commodities at the HS 9-digit level as a "representative" of respective industries.[2] The empirical results obtained by the above empirical approach are hard to be generalized in discussing the ERPT in a broader perspective.

To overcome the weakness of the previous studies, this paper employs a panel estimation as developed by Yoshida (2009) by pooling all 300 export commodities at the HS 9-digit level into fifty-four HS 4-digit classifications. We obtain pass-through coefficients at the HS 4-digit level, which better reflects the similarity of ERPT in Japanese exports at a broader commodity category. The empirical results show that the degree of ERPT has increased in Japanese exports to all destinations, even to the USA, in all industries over the sample period. While Japanese exporting firms have built a regional production network in East Asia and the share of intra-firm trade has been growing in the region (Ito, et al., 2010), the high ERPT is generally observed in

[2] For example, Takagi and Yoshida (2001) analyzed only 11 commodities for estimating pass-through coefficients for Japanese exports to East Asia. Sato (2003) collected 13 commodities, Parsons and Sato (2008) selected 27 commodities.

Japanese exports to East Asia. Our findings of the rising ERPT have important implications for the price setting behavior of exporting firms in the growing production network.

The paper is organized as follows. Section 2 presents the empirical model. Section 3 describes the data. Section 4 discusses the estimated results. Finally, Section 5 concludes.

2. THE EMPIRICAL MODEL

We employ the standard regression equation used in the literature such as Knetter (1989) and Yoshida (2009) to estimate the extent of ERPT by commodity and by destination country:

$$\Delta \ln p_{it} = \alpha_i + \beta \Delta \ln S_{jt} + \gamma \Delta \ln PPI_{it} + \delta \Delta \ln IPI_{jt} + \varepsilon_{it}, \qquad (1)$$

where Δ denotes the first-difference operator; i, j and t indicate the exported commodity, importing country and time, respectively; p is the export price in yen; α is the cross-section effect; S_j is the bilateral nominal exchange rate of the yen vis-à-vis the importer j's currency; PPI_i is the yen-based Japanese producer price index of i industry (a proxy for the exporter's marginal cost); IPI_j is the industrial production index of country j (a proxy for the destination market demand); and ε is an error term. By using the augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test, it is found that most variables are non-stationary in level but stationary in first-differences. Thus, we employ the first-difference model for estimation.[3]

Our pass-through coefficients are different from those of previous studies such as Knetter (1989) and Parsons and Sato (2008). While the pass-through coefficient is typically estimated for a single commodity at the HS 9-digit level, we obtain the common pass-through coefficients at the HS 4-digit level by pooling HS 9-digit commodities into respective HS 4-digit classifications, which enables us to evaluate the degree of ERPT at more aggregated level than the previous

[3] The results of unit-root tests are not reported in this paper, but available upon request.

studies. β in equation (1) obtained by the panel estimation can be interpreted as follows. If the null hypothesis of $\beta = 0$ cannot be rejected, full pass-through (or no PTM) is commonly conducted by exporters of HS 9-digit commodities categorized in the HS 4-digit classification. If β is significantly positive but smaller than unity, it is incomplete pass-through or incomplete pricing-to-market (PTM). $\beta = 1$ indicates "no pass-through" or complete PTM.

3. DATA

We use the destination breakdown data on export prices at the HS 9-digit level. Both amounts and quantity of export commodities are collected from the website of the Ministry of Finance, Trade Statistics of Japan, and we compute the unit values for each commodity by dividing the amounts of exports in the yen by the corresponding quantities. Nine destination countries are chosen: the USA, China, Korea, Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam. The whole sample period spans from January 1988 to December 2008. To exclude the effect of Asian currency crisis, we divide the whole sample into two sub-samples, i.e., the pre-crisis (from January 1988 to December 1996) and the post-crisis periods (from January 2000 to December 2008), by excluding the crisis period from 1997 to 1999. The commodity breakdown of PPI is obtained from the website of the Bank of Japan (2005 base). IPI is taken from the IMF, *International Financial Statistics* (henceforth IFS), CD-ROM and the CEIC Database (2005 = 100 for the US, Korea and Malaysia; 2000 = 100 for the others). Both PPI and IPI are seasonally adjusted. Monthly series of the bilateral nominal exchange rates (vis-à- vis the US dollar) are taken from the IFS. We calculate the cross rate, i.e., the bilateral nominal exchange rate of the yen vis-à-vis the importer's currency.

We use three hundred commodities at the HS 9-digit level collected from the Japan's top four industries in terms of export amounts: general machinery, electric machinery, iron and steel,

and transport equipment.[4] By pooling HS 9-digit commodities into HS 4-digit classification, we show the results of ERPT estimation for fifty-four HS 4-digit classifications.

4. EMPIRICAL RESULTS

Table 1 presents the summary results of the pass-through coefficients at the HS 4-digit classifications. A notable finding is that Japanese exporters increase the degree of ERPT in the post-crisis period. For instance, it is well known that Japanese automobile exporters generally conduct PTM in the US market. Even in exports to the USA, however, the PTM behavior has declined in the post-crisis period compared to the pre-crisis one. Table 2 shows the detailed results of estimation for exports to the USA. For comparison purpose, the results for Singapore are also reported as a representative of the East Asian countries. The detailed results for other East Asian countries are not presented in this paper, but available upon request. Japanese exporters tend to pass through exchange rate changes to East Asian importers in all industries, while PTM is observed in some cases in the electric machinery industry. However, in the post-crisis period, a decline of PTM behavior becomes more pronounced, and the Japanese exporters have stronger tendency to pass through the exchange rate risk to East Asian importers, perhaps, except for Vietnam.

5. CONCLUDING REMARKS

In contrast to the previous studies, our panel estimation approach enables us to investigate the destination specific ERPT at a broader commodity category. It is found that the degree of ERPT has increased over the sample period in exports to all destinations, even to the USA, which

[4] Since we use the destination breakdown data on highly disaggregated export commodities, we often have missing values in time-series data on HS 9-digit commodities. We exclude the commodity from our sample if it has 20 or more of missing values in the whole sample period.

differs markedly from the findings of the previous studies. The results of estimation at an industry level also show the rising ERPT in all industries in exports to all countries. While Japanese automobile exports to the USA are considered as a typical example of the PTM behavior, our results reveal that ERPT has prevailed even in Japanese automobile exports to the US market. It is often pointed out that Japanese exporters have suffered from an appreciation of the yen. Our findings imply that Japanese exporting firms have changed their pricing behavior in the 2000s, which may reflect their growing production network established in East Asia. This conjecture needs to be examined by further empirical analysis.

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Table 1: The Summary of the Pass-through Coefficients by Industry and by Country

Industry	Destination Country	Pre-crisis Eq.(1): β		Post-crisis Eq.(1): β	
		PTM	Full PT	PTM	Full PT
Iron and steel	China	0	3	1	2
	Korea	0	4	0	4
	Singapore	0	1	0	2
	Malaysia	0	3	0	3
	Indonesia	0	1	0	1
	Vietnam	n.a.	n.a.	0	3
General Machinery	USA	2	10	1	11
	China	2	8	0	10
	Korea	1	9	0	10
	Singapore	2	8	0	10
	Malaysia	0	8	0	7
	Philippines	0	11	0	11
	Thailand	0	12	0	12
	Indonesia	1	10	0	11
	Vietnam	n.a.	n.a.	4	3
Electric machinery	USA	7	21	3	26
	China	2	20	3	21
	Korea	2	22	0	24
	Singapore	5	22	1	25
	Malaysia	4	21	2	23
	Philippines	3	23	0	26
	Thailand	3	20	1	22
	Indonesia	3	16	2	17
	Vietnam	n.a.	n.a.	5	12
Transport equipment	USA	5	1	3	3
	China	1	3	0	4
	Korea	0	4	0	4
	Singapore	1	4	0	5
	Malaysia	0	6	0	6
	Philippines	1	7	1	7
	Thailand	2	5	2	5
	Indonesia	0	4	0	3
	Vietnam	n.a.	n.a.	0	4

Note: All positive and significant coefficients are counted as PTM. Insignificant coefficients are counted as Full PT (pass-through). Negative and significant coefficients are not counted in this table.

Table 2: The Results of Pass-through Coefficients in Exports to the USA and Singapore

HS4 code	Code Description	Exports to USA				Exports to Singapore			
		1988M1-1996M12 Yen/USD		2000M1-2008M12 Yen/USD		1988M1-1996M12 Yen/SGD		2000M1-2008M12 Yen/SGD	
		β	s.e.	β	s.e.	β	s.e.	β	s.e.
(a) Iron and steel									
7202	Ferro-alloys	0.54	0.42	-0.48	0.70	n.a.	n.a.	n.a.	n.a.
7205	Granules and powders	1.77	1.88	1.90	2.18	4.54	3.20	1.86	1.49
7210	Flat-rolled products of iron of 600 mm	-4.05#	1.86	-1.82	1.61	-3.52*	1.74	0.32	0.37
7212	Flat-rolled products of iron, less than 600 mm	-0.67	1.82	-2.93	2.46	n.a.	n.a.	n.a.	n.a.
(b)General Machinery									
8407	Spark-ignition reciprocating	0.75*	0.40	0.66*	0.29	1.28	1.14	0.11	0.53
8408	Compression ignition	0.77**	0.25	0.18	0.17	-0.30	0.99	0.17	0.72
8409	Parts suitable for 8407,8408	0.40	0.29	0.02	0.37	-0.09	0.62	-0.93	0.64
8412	Other engines and motors	0.86	0.90	0.73	0.60	-0.69	0.94	0.26	0.97
8413	Pumps for liquids elevators	0.28	0.42	0.46	0.46	1.89**	0.65	-0.70	0.71
8414	Air or vacuum pumps	-0.26	0.54	0.60	0.57	-0.74	0.69	1.23	0.82
8417	Industrial furnaces and ovens	-4.04	3.58	0.42	3.19	n.a.	n.a.	n.a.	n.a.
8418	Refrigerators, electric, heat pumps	0.57	0.61	0.86	0.97	0.96*	0.46	1.06	0.77
8419	Machinery equipment	0.79	0.89	1.16	0.80	-0.05	1.13	0.74	1.19
8420	Other rolling machines	3.20	2.32	1.36	2.80	n.a.	n.a.	n.a.	n.a.
8421	Centrifuges machinery	0.50	0.62	0.26	0.69	-0.63	0.86	-0.65	0.82
8422	Dish washing machines	0.02	0.62	-0.07	0.52	1.31	2.33	-1.85	3.44
(c) Electric machinery									
8501	Electric generators	0.24	0.36	0.08	0.27	1.80**	0.72	0.90	0.74
8502	Electric generating rotary converters	0.37	0.48	0.62*	0.27	0.52	1.02	-0.60	1.00
8504	Electrical transformers, static converters	0.41	0.42	1.05#	0.64	-0.51	0.96	0.64	1.21
8505	Electro-magnets, permanent magnets	1.10**	0.39	1.29**	0.34	0.60	0.83	-1.21	0.95
8507	Electric accumulators	0.67	0.67	0.72	1.05	0.97	0.74	-0.69	1.54
8509	Electro-mechanical	n.a.	n.a.	n.a.	n.a.	-0.37	0.93	0.67	0.71
8510	Shavers, hair clippers	0.06	1.06	0.70	0.76	n.a.	n.a.	n.a.	n.a.
8511	Electrical ignition	0.48#	0.29	0.32	0.23	1.07	0.71	1.82#	1.13
8512	Electrical lighting	0.18	0.24	0.50	0.45	-0.14	0.67	-0.10	0.79
8514	Industrial electric furnaces	n.a.	n.a.	n.a.	n.a.	1.47	2.66	-1.64	2.70
8515	Electric laser	0.90	0.76	0.24	0.75	0.90	1.11	2.04	1.68
8516	Electric instantaneous heaters	0.16	0.35	0.79	0.69	0.30	0.59	0.58	1.20
8518	Microphones, loudspeakers	0.81**	0.29	0.45	0.50	0.89#	0.55	0.56	1.11
8521	Video recording	1.25**	0.29	0.34	0.56	0.51	0.33	-1.69	1.78
8522	Parts suitable for 8519 to 8521	-1.28	0.96	0.51	1.17	n.a.	n.a.	n.a.	n.a.
8526	Radar apparatus	0.71	0.84	0.10	0.41	0.18	0.59	2.78	1.74
8527	Reception apparatus	1.00#	0.55	0.96	0.69	n.a.	n.a.	n.a.	n.a.
8529	Parts suitable for 8525 to 8528	0.46	0.65	-0.16	0.87	0.62	0.99	-0.19	1.61
8531	Electric sound	-0.01	0.60	-0.03	0.75	-0.39	1.45	-2.86*	1.23
8532	Electrical capacitors	0.44	0.47	0.23	0.74	1.40*	0.62	0.46	0.49
8533	Electrical resistors	0.08	0.94	1.12	0.90	1.61*	0.80	-0.15	0.51
8535	Electrical apparatus	-3.98#	2.46	-8.05*	4.01	n.a.	n.a.	n.a.	n.a.
8536	Electrical apparatus not exceeding 1000volts	0.85*	0.38	-0.43	0.58	1.19**	0.49	0.56	0.34
8537	Boards, panels	n.a.	n.a.	n.a.	n.a.	0.77	1.46	1.43	2.44
8538	Parts suitable for 8535 to 8537	0.02	0.48	-0.14	0.46	-0.56	1.83	2.20	1.39
8539	Electric filament	0.22	0.47	0.29	0.58	0.80	0.73	0.21	0.79
8540	Thermionic, valves	0.13	1.38	-0.87	1.74	0.23	1.05	-2.07	1.68
8541	Diodes, transistors	-1.00	0.81	0.39	0.63	0.28	0.63	0.52	0.48
8543	Electrical machines	-2.61#	1.44	-0.31	1.57	1.60	1.90	2.04	2.36
8544	Insulated wire, cable,	0.16	1.04	0.45	1.40	0.27	0.75	-1.15	1.47
8545	Carbon electrodes	1.86	1.48	1.34	3.49	n.a.	n.a.	n.a.	n.a.
8546	Insulated wire, cable,	-3.41	2.84	3.09	3.67	n.a.	n.a.	n.a.	n.a.
8547	Insulating fittings	1.44**	0.45	0.69	0.75	0.37	0.56	0.84	1.21
(d) Transport equipment									
8701	Tractors	0.69**	0.14	0.53**	0.10	n.a.	n.a.	n.a.	n.a.
8703	Motor cars and other motor vehicles	0.54**	0.10	2.32**	0.77	0.00	0.44	0.16	0.19
8704	Motor vehicle for the transport of goods	0.68**	0.08	-0.09	0.87	n.a.	n.a.	n.a.	n.a.
8705	Special purpose motor vehicles	n.a.	n.a.	n.a.	n.a.	-3.21	2.40	0.28	1.33
8708	Parts of motor vehicles	0.45**	0.12	0.49**	0.17	0.02	0.60	0.46	0.68
8714	Parts of 8711 to 8713	0.74*	0.35	-0.05	0.40	1.14	1.39	-0.18	1.15
8716	Trailers and semi-trailers	1.30	1.35	0.81	3.43	2.54*	1.38	-0.23	2.08

Note: Double asterisks (**), single asterisk (*) and a sharp (#), respectively, denote the 1 percent, 5 percent and 10 percent significance level.
β denotes the pass-through coefficients for each HS 4-digit classification. 's.e.' indicates the standard errors.