2021

Exchange rate pass-through into Japanese import prices: Evidence at both bilateral and product levels

Channary Khun
International Fund for Agricultural Development

Sokchea Lim
John Carroll University, slim@jcu.edu

Hem Basnet
Methodist University

Recommended Citation

Exchange Rate Pass-Through into Japanese Import Prices: Evidence at Both Bilateral and Product Levels

Channary Khun
International Fund for Agricultural Development, Rome, Italy

Sokchea Lim
John Carroll University, Ohio, U.S.

Hem Basnet
Methodist University, North Carolina, U.S.

Exchange Rate Pass-Through into Japanese Import Prices: Evidence at Both Bilateral and Product Levels

Channary Khun[a], Sokchea Lim[b], and Hem C. Basnet[c]

ABSTRACT

This study investigates the degree of the exchange rate pass-through to Japanese bilateral import prices at the product level for major Japan's trading partners (US, EU, and Asian NIEs) for a period (1998:1-2010:12) dubbed as Japan's lost decade and marked by a gradual the exchange rate appreciation against the US dollar. By considering both country and product dimensions in a unified framework, this study makes one of the first attempts to analyze the responsiveness of Japanese import prices to exchange rate movement. The empirical analysis suggests a declining exchange rate pass-through to Japanese import prices at the bilateral level in some product categories but increasing in others. However, we find no evidence of the changes in exchange rate pass-through for manufacturing, machinery, and overall product level for each of these partners. Our finding sheds light on the recent decline in exchange rate pass-through to Japanese multilateral import prices and helps calibrate its trade relationship with its partner countries.

INTRODUCTION

The extent to which exchange rate movements pass into import prices has long been a key discussion element among policymakers. One of the vital transmission channels of international spillover of inflation to domestic prices is exchange rate movement, known as exchange rate pass-through (ERPT).[1] The ERPT refers to the percentage change in prices in response to the exchange rate movement. The ERPT into import prices has also been of interest in international finance, with the research on the topic evolving. Several economic factors, such as openness, the output gap, exchange rate regime, expectations, etc., influence the degree of pass-through (i.e., pass-through elasticity) (see Steel & King, 2004; Ghosh & Rajan, 2009; Jimborean, 2013). A complete pass-through refers to a one-on-one relationship between the change in the exchange rate and (import) prices, while the pass-through is incomplete if the price change is less than the exchange rate change.

Previous studies find that the pass-through is incomplete. That is, the pass-through elasticity is less than 1 (Goldberg & Knetter, 1997; Campa & Goldberg, 2005). A high exchange rate pass-through into import prices ultimately affects inflation as a whole, prompting the central bank to take policy

―――――――――――――――――――――
[a] International Fund for Agricultural Development, Rome, Italy; email: c.khun@ifad.org
[b] John Carroll University, Ohio, U.S.; email: slim@jcu.edu
[c] Methodist University, North Carolina, U.S.; email: hbasnet@methodist.edu

Corresponding Author:
Basnet (hbasnet@methodist.edu)

[1] We use the term "pass-through" and the shortcut "ERPT" interchangeably in the text.

measures to curb it. Conversely, a low pass-through may not concern the monetary authority about the pass-through induced inflation as much; consequently, the central bank may devote resources to other objectives such as employment and economic growth (Jiménez-Rodríguez & Morales-Zumaquero, 2016). Additionally, incomplete pass-through implies a low expenditure-switching effect of nominal exchange rate movements. The monetary policy could become less effective in expanding domestic demand if domestic currency depreciation makes consumers less likely to switch from foreign goods towards domestic substitutes. Therefore, the dynamic of the pass-through and what causes it to be partial are essential to the workings of monetary policy (Malenbaum, 2019). The fact that exchange rate movements do not completely pass through to import prices has prompted extensive theoretical and empirical studies to identify potential contributing factors. However, most previous studies examine the issue at the bilateral or product level, if not at the multilateral and aggregated commodity level (see Ghosh & Rajan, 2009; Jimborean, 2013). Studies, which simultaneously take into account heterogeneity across countries and product categories, are scant.

In this study, we re-examine the ERPT and investigate the stability of pass-through into Japanese bilateral import prices from its major trading partners at the disaggregated (i.e., commodity categories such as food, apparel, raw materials, etc.) product level. More specifically, we estimate Japanese pass-through into bilateral import prices from the US, the European Union (EU), and Asia's Newly Industrialized Economies (NIEs--Hong Kong, Korea, Singapore, and Taiwan) for aggregate manufacturing, overall product level, and disaggregated product level including foods, raw materials, fuels, apparel, chemicals, metals, and machinery. We use monthly data on Japanese import price indices from 1998:1 to 2010:12. We are interested in examining the ERPT for this particular period because it is known as Japan's lost decade, during which period the economy suffered from deflation and slow economic growth. The Japan/US exchange rate was also on a decline (i.e., Japanese yen appreciated).

PASS-THROUGH TREND

Recent literature has documented a declining trend in ERPT in advanced and industrialized countries than in developing and emerging countries (see, Bussière, Chiaie, & Peltonen, 2014; Civcir & Akçağlayan, 2010; Goldberg & Campa, 2010; Marazzi et al., 2005). Malenbaum (2019) documents the declining trend in exchange rate pass-through to US import prices from China. He attributes the declining trend to China's growing market share in US. Using a Belgian firm-level dataset, Amiti, Itskhoki, and Konings (2014) echo the same that the degree of ERPT is lower for firms with higher imports and market shares. However, Jiménez-Rodríguez and Morales-Zumaquero (2016) and Shintani et al. (2013) attribute the low ERPT in G-7 countries and the US to a more stable monetary policy and low inflation.

From the standpoint of currency appreciation/depreciation, Delatte and López-Villavicencio (2012), in their study on four advanced economies (Japan, Germany, the United Kingdom, and the United States) from 1980 to 2009, find that depreciation was transmitted to prices at a higher speed than appreciation. Brun-Aguerre et al. (2016) analyze the ERPT in import prices for 14 emerging nations and 19 developed nations from 1980Q1 to 2010Q4. They also show that exchange rate changes substantially affect import prices during depreciation rather than appreciation periods. Kassi et al. (2018) find a significant and complete ERPT for appreciation, higher during local currency appreciation than depreciation in the long-term.

Investigating the degree and the speed of exchange rate pass-through to import prices, Yanamandra (2015) suggests a more than complete exchange rate pass-through into Indian import prices both in the short run and in the long run. However, Chang and Tsong (2010) find the partial

exchange rate pass-through in the short run and the complete pass-through in the long run-in import prices in Taiwan.

EVIDENCE FOR JAPAN

Phuc & Duc (2021) investigate the effect of ERPT on domestic prices in four developed countries: Australia, New Zealand, Japan, and South Korea. Their evidence indicates a rise in ERPT to import prices after the recent financial crisis in Japan, Korea, and New Zealand, but a relatively stable in Australia. However, Ceglowski (2010) finds a substantial decline in pass-through rate to US bilateral import prices from Japan. Likewise, Ihrig et al. (2006) document a fall in the responsiveness of import prices to exchange rate fluctuations for about half of the G-7 countries since the late 1970s and 1980s, with a significant decline associated with Japanese pass-through. Otani et al. (2005) report considerable reductions in Japanese ERPT into import prices in each product category during the 1990s. Campa and Goldberg (2005) also show evidence of incomplete but stable industry-specific pass-through rates for 23 OECD countries over 1975-2003. Other studies (i.e., Marazzi et al., 2005; Hellerstein et al., 2006; Olivei, 2002) estimate US pass-through across disaggregated commodity categories and provide a mixed picture on the direction as well as the extent of structural change in the pass-through rates, suggesting persistent heterogeneity across commodity categories.

SIGNIFICANCE OF THE STUDY

As is evident from the above discussion that while the empirical literature on ERPT into import prices is rich, most of these studies in the Japanese case focus on import prices at the aggregate products level. There is a notable gap of studies in the literature that account for heterogeneity across countries and product categories simultaneously. An exception is Gaulier et al. (2008), who incorporate both dimensions to examine pass-through rates for 130 countries, including Japan. The focus of their paper is, however, on the divergence of ERPT coefficients across countries. They find a high degree of heterogeneity across products and countries. Understanding the existence of ERPT heterogeneity across product categories helps policymakers to devise appropriate and effective policy responses. Conversely, ignoring it may result in improper identification of the relative impact of macroeconomic and industry-specific variables, leading to estimation bias, especially in the context of dynamic regression estimates (Gaulier et al., 2008; Mumtaz et al., 2006). Heterogeneity across trading partners further complicates the issue, potentially offering misleading results when the analysis is performed at a multilateral level. Ceglowski's (2010) findings of the fall in US pass-through into bilateral import prices for some but not all of its trading partners could present compelling evidence in this regard. Hence, a careful analysis of ERPT necessitates estimating the pass-through into import prices at the bilateral and disaggregated commodity categories. This is precisely the approach we have taken in this study.

   The paper contributes to the existing literature on Japanese pass-through in two aspects. First, by introducing geographical dimension, it complements recent empirical research on pass-through into multilateral import prices (Ihrig et al., 2006; Campa and Goldberg, 2005; Otani et al., 2005). Additionally, our finding can potentially shed light on the recent decline in exchange rate pass-through to Japanese multilateral import prices. Second, it further examines the pass-through rate to bilateral import prices from each major trading partner at the commodity level. While Otani et al. (2005) have investigated Japanese ERPT at the product level, they do not take into account heterogeneity across countries, and this study intends to fill the gap. More importantly, by introducing both country and product dimensions in a unified framework, this study provides the first comprehensive analysis of the responsiveness of Japanese import prices to exchange rate movement.

The rest of the paper is structured as followed: Section 2 specifies the equations and details the data used in the paper, while regression results on the elasticity of ERPT are reported in Section 3. In Section 4, we show evidence for the stability of the pass-through, followed by the discussion in Section 5. Finally, Section 6 provides a conclusion.

MODEL SPECIFICATION AND DATA

Applying a multilateral import price equation from Campa and Goldberg (2005) to the analysis of bilateral import prices in each disaggregated product category, the equation can be specified as:

$$lnP_{ijt} = \beta_o + \beta_1 lnE_{ijt} + \beta_2 lnC_{jt} + \beta_3 lnY_{it} + u_{ijt} \tag{1}$$

where subscripts index Japan *(i)*, partner countries *(j)*, and time periods *(t)*; P_{ijt}, the local-currency price of country *i'*s imports from country *j*, is a function of the bilateral exchange rate (E_{ij}), C_j refers to a measure of costs in country *j*, and Y_i refers to economic activity or market demand conditions in Japan. The variable of interest is lnE_{ijt}, whose coefficient (β_1) indicates the degree of short-term ERPT into bilateral import prices in each commodity category. Since E_{ijt} is calculated as the ratio of domestic currency to foreign currency, β_1 should take the value between 0 and 1, with 0 indicating no pass-through and 1 suggesting complete pass-through. Furthermore, the increase in the exchange rate measure reflects the depreciation of the domestic currency.

First, the unit root tests are performed using Augmented Dickey-Fuller (*ADF*) and Phillips-Perron (*PP*). The number of lags on the specification are determined by the Schwarz Information Criterion (*SIC*). The test results are presented in Table 1.

Table 1. Unit Root Test

Variables	Augmented Dickey-Fuller		Phillips-Perron	
	level	First Difference	Level	First Difference
Japan				
Industrial production index	-3.697***	–	-6.936***	–
EU				
Exchange rate	-1.432	-8.606***	-1.282	-8.693***
Producer price index	-0.109	-6.271***	0.046	-6.271***
Import price index				
Manufacturing	-1.291	-13.566***	-1.564	-21.247***
Apparel	-1.687	-2.414	-1.877	-12.933***
Chemicals	-1.097	-11.904***	-1.607	-21.046***
Food	-1.896	-15.509***	-2.127	-15.509***
Fuel	-1.567	-10.972***	-3.049**	–
Machinery	-2.077	-13.682***	-2.728*	–
Metal	-1.580	-14.017***	-1.633	-13.912***
Raw materials	-1.520	-13.603***	-1.500	-13.563***
Total product	-1.220	-13.566***	-1.447	-19.784***
Asian NIES				
Exchange rate	-2.211	-8.877***	-2.020	-8.846***
Producer price index	-0.682	-6.534***	-0.354	-4.531***
Import price index				
Manufacturing	-1.993	-10.905***	-2.042	-11.001***
Apparel	-2.222	-10.590***	-2.432	-10.594***
Chemicals	-1.306	-10.543***	-1.306	-13.021***
Food	-1.940	-12.548***	-1.965	-12.549***
Fuel	-1.723	-7.284***	-1.233	-6.664***
Machinery	-1.132	-12.536***	-0.850	-13.099***
Metal	-0.885	-4.320***	-0.556	-8.497***
Raw materials	-1.860	-14.543***	-1.782	-14.465***
Total product	-2.061	-10.078***	-1.818	-9.856***
US				
Exchange rate	-1.107	-9.739***	-0.984	-9.766***
Producer price index	-0.520	-8.729***	-0.471	-8.850***
Import price index				
Manufacturing	-2.528	-7.952***	-2.94**	–
Apparel	-1.813	-11.102***	-1.898	-16.019***
Chemicals	-2.529	-18.298***	-3.238**	–
Food	-1.765	-9.433***	-1.679	-9.42***
Fuel	-0.696	-14.111***	-0.672	-14.01***
Machinery	-2.383	-19.906***	-3.73***	–
Metal	-1.301	-11.945***	-1.455	-16.676***
Raw materials	-1.892	-9.976***	-1.852	-9.987***
Total product	-2.224	-8.004***	-2.322	-20.345***

Note: *, **, and *** indicate statistically significant at 10, 5, and 1 percent respectively.

The *ADF* test fails to reject the null hypothesis that the series in level have unit root for all cases except for the Japanese industrial production index. On the other hand, the *PP* test rejects the null hypothesis for the EU import price index in fuel and machinery sectors as well as the US in chemicals, machinery, and manufacturing sectors. However, both tests reject the null hypothesis of unit root at the first difference for all series except for EU apparel, for which the *ADF* test fails to reject the null hypothesis. In brief, the unit root tests of either ADF or PP indicate that the series are non-stationary in the level but stationary in first difference in most of the cases. We, therefore, estimate Eq. (1) using the first-differenced logarithmic values of the variables. The estimated equation is specified as follows:

$$\Delta ln P_{ijt} = \beta_o + \sum_{k=0}^{6} \beta_{1k} \Delta ln E_{ijt-k} + \sum_{k=0}^{6} \beta_{2k} \Delta ln C_{jt-k} + \sum_{k=0}^{6} \beta_{3k} \Delta ln Y_{it-k} + u_{ijt} \qquad (2)$$

In Eq. (2), the modification of Eq. (1), account for gradual adjustment to exchange rate, foreign cost, and domestic economic activity changes. As the literature on ERPT (see Ceglowski, 2010) suggests that most of the import price effect occurs within the six months of a currency change; we estimate the Eq. (2) with the current and six lagged values of the exchange rate, foreign costs, and industrial production indexes. The coefficient of contemporaneous exchange rate gives the short-run elasticity of ERPT (one month) into import prices, while long-term pass-through (six months) can be measured as the sum of coefficients $\sum_{k=0}^{6} \beta_{1k}$.

We additionally perform the Johansen test to determine whether the three series (import price, foreign cost, and exchange rate) are cointegrated. These tests are calculated with lag length determined by SIC[2], no trend, and an unrestricted constant. The results presented in Table 2 indicate that only 6 of the 27 systems involve a single cointegrating vector. The cointegrated pairs are EU apparel and fuel sector, NIEs apparel and US apparel, chemicals and fuel sectors.

---

[2] We also apply Likelihood Ratio test to determine lag length; though the cointegrating series differ, the number of cointegrating series based on Maximum Eigenvalue and Trace are the same.

Table 2. Johansen Test Statistics for Cointegration between Import Prices, Bilateral Exchange Rate, and Foreign Cost

	Maximum eigenvalue			Trace		
	r=0	r<1	r<2	r=0	r<1	r<2
EU						
Manufacturing	17.182	2.712	0.284	20.177	2.995	0.284
Apparel	45.138*	2.729	0.152	48.02*	2.881	0.152
Chemicals	18.424	2.446	0.083	20.953	2.529	0.083
Food	19.459	2.381	0.163	22.002	2.543	0.163
Fuel	32.07*	2.645	0.122	34.837*	2.767	0.122
Machinery	16.830	2.911	0.273	20.015	3.185	0.273
Metal	5.957	2.634	0.104	8.694	2.738	0.104
Raw materials	7.883	2.768	0.110	10.761	2.877	0.110
Total product	16.227	2.514	0.335	19.077	2.849	0.335
Asian NIEs						
Manufacturing	10.986	5.962	0.011	16.960	5.974	0.011
Apparel	36.782*	6.234	0.678	43.694*	6.912	0.678
Chemicals	20.968	2.644	0.373	23.986	3.017	0.373
Food	13.386	6.383	0.056	19.826	6.440	0.056
Fuel	12.043	8.473	1.195	21.710	9.667	1.195
Machinery	9.343	5.983	0.003	15.329	5.986	0.003
Metal	21.629	3.160	0.673	25.461	3.832	0.673
Raw materials	27.394*	5.085	0.411	32.890	5.496	0.411
Total product	10.666	5.170	0.025	15.861	5.195	0.025
US						
Manufacturing	12.441	6.144	0.034	18.620	6.178	0.034
Apparel	27.075*	5.795	0.014	32.884*	5.809	0.014
Chemicals	32.774*	6.413	0.062	39.249*	6.475	0.062
Food	14.357	8.311	0.038	22.706	8.349	0.038
Fuel	47.655*	6.950	0.015	54.62*	6.964	0.015
Machinery	10.992	6.284	0.046	17.322	6.330	0.046
Metal	19.125	6.335	0.023	25.482	6.357	0.023
Raw materials	9.638	7.284	0.024	16.946	7.308	0.024
Total product	13.197	5.892	0.018	19.107	5.911	0.018

Note: Each system includes import prices, bilateral exchange rate, and foreign cost. The lag length is determined by Schwarz Information Criterion. The column labeled r = 0 tests a null of no cointegration, while the r < 1 (r < 2) columns test a null of at most one(two) cointegrating vectors. Asterisks represent rejections of the null hypothesis at 5% level.

Now we perform the analysis using error-correction model (ECM), which is specified as follows:

$$\Delta lnP_{ijt} = \beta_o + \sum_{k=1}^{K} \beta_{1k} \Delta lnE_{ijt-k} + \sum_{k=1}^{K} \beta_{2k} \Delta lnC_{jt-k} + \sum_{k=1}^{K} \delta_k \Delta lnP_{ijt-k} + \gamma e_{ijt-1} + \varepsilon_{ijt} \quad (3)$$

where e_{ijt-1} is the error-correction term and the lag length k is determined by SIC.

Recall that the paper also aims at examining the stability of the pass-through coefficients at the bilateral and commodity levels. For this purpose, Eq. (2) is further modified to include break dates. The equation is specified as follows:

$$\Delta lnP_{ijt} = \beta_o + \sum_{k=0}^{6} \beta_{1k} \Delta lnE_{ijt-k} + \sum_{k=0}^{6} \beta_{2k} \Delta lnC_{jt-k} + \delta_0 D_j + \sum_{k=0}^{6} \delta_{2k} (\Delta lnE_{ijt-k} * D_j) +$$
$$\sum_{k=0}^{6} \delta_{3k} (\Delta lnC_{jt-k} * D_j) + u_{ijt} \tag{4}$$

where D_j is the breakpoint dummy variable of partner j, which takes the value 0 for each observation before the break date and 1 thereafter. We employed the Quandt-Andrew breakpoint test to determine break date as the test does not require that a break date be specified a priori.

Regarding the data for the analysis, we use the unit value of bilateral import data published by the Ministry of Finance Japan (MOFJ) over 1998:1- 2010:12 for the US, the EU, and Asian NIEs. The time span is selected for the period of a lost decade in the Japanese economy where the exchange rate was on a gradual appreciation against the US dollar. The Japanese monthly industrial production index measures domestic economic activity. The exchange rate series are the monthly averages of the bilateral rates against the Japanese Yen for the US and trade-weighted averages of bilateral rates for the Asian NIEs and the EU. Wholesale or producer price indexes are used as foreign cost proxies, expressed as weighted averages for the Asian NIEs and the EU. More detailed measures of the variables and their sources are further described in Appendix.

THE EXTENT OF ERPT

We employ the specification in Eq. (2) to estimate the pass-through rates over the entire sample period for each of the 27 bilateral import price series. The estimated results are summarized in Table 3. We report both short-term and long-term pass-through rates, where the former are represented by the coefficients on the current value of the exchange rate, and the latter are the sums of the coefficients on the current and lagged values of the exchange rate. We find that except for the import price of EU fuel, short-term ERPTs are smaller than long-term in all instances. Furthermore, the pass-through rates in the short-run are partial, while over the long-run producer-currency pricing (PCP) behavior is observed for some commodities imported from the US, including apparel, chemicals, and metal, in addition to raw materials imported from the Asian NIEs. For metal, while Otani et al. (2003) find an almost complete long-run pass-through (0.92) in the aggregate import data, we find that this long-run pass-through is larger for imports from the US (1.176), but smaller for imports from the EU (0.559) and even smaller and insignificant for imports from Asian NIEs (0.224). Similarly, for raw materials, Otani et al. (2003) find the complete long-run pass-through (1.11) while our bilateral results show that the rate is larger for Asian NIEs' imports (1.253), but smaller for imports from the EU (0.764) and US (0.804).

One of the interesting observations of our results is that at the product level, it shows a complete pass-through for apparel imports from the US (1.122), half pass-through from the Asian NIEs (0.53), and smaller and insignificant pass-through from the EU (0.369). For aggregate products, the long-run ERPT for the US is larger (0.804) than for Asian NIEs (0.646), while the coefficient for the EU is smaller and insignificant.

For each of the trading partners, the results across the commodity are also worth noting. While long-run ERPT into import price of manufactured goods are relatively low compared to that of raw materials for the EU (0.268 compared to 0.764) and Asian NIEs (0.617 compared to 1.253), confirming earlier findings (i.e., Campa and Goldberg, 2005), this is not the case for the price of manufactures imported from the US (0.879 compared to 0.804). The high pass-through rate of imports from the US is not limited to manufactured goods; it is also prevalent for other commodities. Indeed, the elasticity of the aggregate pass-through rate is the highest for the import price from the US, followed by that from NIEs and the EU, which are 0.804, 0.646, and 0.286, respectively. These results substantiate

earlier findings that pass-through rates not only vary across commodity categories but also across trading partners.

Table 3. Exchange Rate Pass-Through, Six-Month Lags

	Short term ERPT	Std. error	Long term ERPT	Std. error	Adjusted R²	SEE
EU						
Manufacturing	0.141	(0.104)	0.268	(0.214)	0.246	0.033
Apparel	0.138	(0.174)	0.369	(0.358)	0.210	0.055
Chemicals	-0.217	(0.265)	-0.036	(0.545)	0.051	0.084
Food	-0.037	(0.088)	0.348*	(0.181)	0.197	0.028
Fuel	0.670	(0.406)	0.363	(0.836)	0.010	0.129
Machinery	0.245*	(0.129)	0.311	(0.266)	0.159	0.041
Metal	0.522***	(0.138)	0.559*	(0.284)	0.321	0.044
Raw materials	0.390***	(0.108)	0.764***	(0.222)	0.165	0.034
Total product	0.120	(0.092)	0.286	(0.19)	0.249	0.029
Asian NIEs						
Manufacturing	0.262***	(0.09)	0.617***	(0.223)	0.240	0.025
Apparel	0.405***	(0.106)	0.530**	(0.261)	0.353	0.030
Chemicals	0.242**	(0.104)	0.601**	(0.257)	0.287	0.029
Food	0.164*	(0.085)	0.476**	(0.209)	0.196	0.024
Fuel	0.141	(0.156)	0.646*	(0.383)	0.624	0.044
Machinery	0.287**	(0.133)	0.713**	(0.326)	0.127	0.037
Metal	0.082	(0.06)	0.224	(0.147)	0.385	0.017
Raw materials	0.616**	(0.26)	1.253*	(0.64)	0.259	0.073
Total product	0.284***	(0.079)	0.646***	(0.194)	0.356	0.022
US						
Manufacturing	0.258	(0.205)	0.879*	(0.478)	0.164	0.055
Apparel	0.540***	(0.165)	1.122***	(0.385)	0.213	0.045
Chemicals	0.483**	(0.205)	1.090**	(0.477)	0.145	0.055
Food	0.441***	(0.072)	0.708***	(0.168)	0.513	0.019
Fuel	0.594**	(0.232)	0.713	(0.539)	0.184	0.063
Machinery	0.143	(0.269)	0.702	(0.626)	0.088	0.073
Metal	0.763***	(0.207)	1.176**	(0.482)	0.167	0.056
Raw materials	0.608***	(0.100)	0.804***	(0.234)	0.528	0.027
Total product	0.281*	(0.162)	0.804**	(0.376)	0.217	0.044

Note: The coefficient slightly greater one indicates a complete pass-through. Each equation includes a constant term and the current and six lagged values of the exchange rate, foreign price terms, and industrial production index. The estimation period is 1998:01-2010:12 and the sample size is 156. Standard errors are shown in parentheses in the following column. *, **, *** indicate statistically significant at the 10, 5, 1 percent level.

Table 4 presents error-correction estimates for the six sectors for which Johansen test indicates rejection of the null of no cointegration. The estimates include the current and lagged value of

the first-differenced logarithmic exchange rate and foreign producer price terms.[3] The coefficients on the lag first differences of the exchange rate terms measures short-run pass-through while lagged exchange rate in the error-correction term measure long-run elasticity of ERPT. The short-run ERPTs are clustered around 0.4 and 0.5. Estimates of long-run pass-through range from 0.5 to 1. To compare with the results of Table 3, both short-run and long-run ERPTs are quite comparable for imports from the Asian NIEs and US, but not from the EU. While the results in Table 3 show small and insignificant ERPTs in both short and long run for apparel and fuel imports from the EU, the results from the cointegration equation (Table 4) show that there is a half pass-through for apparel imports in the short run while the pass-through rises to 0.823 for apparel and 0.629 for fuel in the long run.

Table 4. Error Correction Estimates

| | ΔExchange Rate (-1) | ΔExchange Rate (-2) | ΔForeign Producer Price (-1) | ΔForeign Producer Price (-2) | Error Correction Term | | | Adj. R² | SEE |
					Lagged Import Price	Lagged Exchange Rate	Lagged Foreign Price		
EU									
Apparel	0.507***	-0.263	-1.187	-1.144	1	-0.823***	-0.508***	0.289	0.053
	(0.159)	(0.165)	(1.169)	(1.158)		(0.063)	(0.142)		
Fuel	-0.192	0.693**	-1.090	3.318	1	-0.629***	-1.297***	0.385	0.101
	(0.307)	(0.314)	(2.209)	(2.166)		(0.1)	(0.228)		
Asian NIEs									
Apparel	0.483***	0.086	-0.164	-0.546	1	-0.748***	-0.501***	0.296	0.031
	(0.103)	(-0.112)	(0.392)	(0.39)		(0.076)	(0.097)		
US									
Apparel	0.574***	0.147	0.295	-0.088	1	-1.071***	-1.386***	0.200	0.045
	(0.162)	(0.174)	(0.301)	(0.312)		(0.116)	(0.085)		
Chemicals	0.407	--	0.307	--	1	-0.844***	-0.852***	0.392	0.047
	(0.174)**		(0.307)			(0.083)	(0.062)		
Fuel	0.567***	--	-0.645	--	1	-0.458***	-3.028***	0.317	0.057
	(0.181)		(0.419)			(0.161)	(0.121)		

Note: Error correction equations are estimated only for those series for which Johansen and error correction tests indicated rejection of the null of no cointegration. The lag length of the equations is determined by SIC. The error correction term is estimated as part of the equation. Standard errors are shown in parentheses. *, **, and *** indicates statistical significance at the 10, 5, and 1 percent level.

THE STABILITY OF ERPT

A number of recent papers have presented evidence of a fall in pass-through to Japanese import prices for the 1970s using aggregate level product data (i.e., Ihrig et al., 2006; Campa and Goldberg, 2005). The present study examines whether the trend still holds while using the bilateral import price series disaggregated by countries and product categories. The issue of pass-through stability is investigated using several tests for structural changes. We first employ the Quandt-Andrew breakpoint test, which does not require that a break date be specified a priori. Because this study focuses on pass-through, the tests are conducted with an eye to detect instability in the exchange rate coefficients. The test statistics significant at five percent level or lower identify possible structural breaks in one or more of

---

[3] The lag length of the equations is determined by SIC.

the exchange rate coefficients for import prices from all sectors except for EU machinery and US chemicals sectors (Table 5). Table 5 also reports both the F-statistics for a test of structural change in the exchange rate coefficients and the sums of the coefficients on the exchange rate dummy variables. These provide two tests of pass-through stability: the F-statistic tests the null that the coefficients on the exchange rate dummy variables are jointly zero and second, the sum of the coefficients on the exchange rate dummies can be used to evaluate the post-break value of long-run pass-through.

The F-statistics reject the null that the exchange rate dummy variables are jointly zero for about half of the break dates. The sums of the coefficients on the exchange rate dummies are positive and significant for apparel, food, fuel, metal and raw material imports from the EU; for chemicals, fuel and metal imports from Asian NIEs; and for food and raw material imports from the US. This indicates an increase in the pass-through in those product categories after their respective break date. On the other hand, the sum of the coefficients of exchange rate dummy variable in some other cases including chemical imports from the EU, food and raw material imports from Asian NIEs and apparel, fuel and metal imports from the US are negative and statistically significant, implying a decrease in the pass-through after their respective break date. However, for some of the cases the F-statistics fail to reject the null hypothesis that the exchange rate dummy variables are jointly zero although the sum of the coefficients on the exchange rate dummies are statistically different from zero. More interestingly, there is no evidence of any changes in the ERPT for manufacturing, machinery, overall product imports from the three trading partner countries. The tests fail to reject the null that exchange rate variables are jointly zero and the sum is zero.

Table 5. Stability Test for Exchange Rate Coefficients

	Break Date	Exchange Rate	Std. Error	Sum of Exchange Rate Dummies	Std. Error	F-statistic	P-value
EU							
Manufacturing	2008M03	0.300***	(0.03)	0.093	(0.091)	0.924	(0.490)
Apparel	2001M01	-0.718	(0.799)	1.668**	(0.802)	2.687**	(0.013)
Chemicals	2007M11	0.442***	(0.066)	-0.421***	(0.149)	1.729	(0.109)
Food	2003M04	0.442***	(0.054)	0.189**	(0.072)	1.086	(0.377)
Fuel	2003M01	0.356*	(0.203)	0.587**	(0.247)	1.296	(0.258)
Metal	2007M05	0.123**	(0.051)	1.705***	(0.107)	40.192***	(0)
Raw materials	2002M05	0.439*	(0.228)	0.666***	(0.237)	1.484	(0.180)
Total product	2008M03	0.308***	(0.027)	0.119	(0.081)	1.231	(0.291)
Asian NIEs							
Manufacturing	2001M05	1.041**	(0.459)	-0.343	(0.461)	0.342	(0.933)
Apparel	2005M03	0.467***	(0.097)	0.161	(0.107)	7.002***	(0)
Chemicals	2003M09	0.425***	(0.11)	0.239**	(0.116)	1.552	(0.157)
Food	2001M06	1.389***	(0.285)	-1.051***	(0.286)	2.552**	(0.018)
Fuel	2000M06	-2.215***	(0.742)	3.473***	(0.745)	4.222***	(0)
Machinery	2001M05	1.111*	(0.662)	-0.113	(0.665)	0.388	(0.908)
Metal	2004M04	0.071	(0.127)	0.556***	(0.134)	2.828***	(0.009)
Raw materials	2007M07	1.473***	(0.135)	-0.476**	(0.205)	2.315**	(0.030)
Total product	2001M05	0.924**	(0.41)	-0.154	(0.412)	0.347	(0.930)
US							
Manufacturing	2001M01	0.785	(0.542)	-0.211	(0.547)	0.439	(0.876)
Apparel	2008M05	1.081***	(0.079)	-0.758***	(0.166)	(6.213)***	(0)
Food	2008M02	0.598***	(0.074)	0.690***	(0.125)	4.684***	(0)
Fuel	2005M12	1.445***	(0.121)	-1.205***	(0.143)	10.49***	(0)
Machinery	2001M01	0.973	(0.706)	-0.503	(0.713)	0.514	(0.822)
Metal	2006M01	1.047***	(0.112)	-0.383***	(0.135)	2.057*	(0.054)
Raw materials	2006M12	0.552***	(0.101)	0.624***	(0.125)	4.065***	(0.001)
Total product	2001M01	0.765*	(0.422)	-0.171	(0.426)	0.899	(0.510)

Note: The coefficient estimates reported for the exchange rate and the exchange rate dummy variable are the sums of the coefficients on the current and six lagged values of these variables. The reported sums of the dummy variables for the exchange rate indicate post-break changes in cumulative pass-through. The F-statistics test the null that the exchange rate dummy variables are jointly zero. Unless otherwise indicated, standard errors are shown in parentheses. *, **, and *** indicates statistical significance at the 10, 5, and 1 percent level.

DISCUSSION

In this section, we explain the causes of the changing ERPT over time. More specifically, why is a declining pass-through evident for one product category or for one trading partner but not the other? One possible explanation is there is a change in the import composition (Campa and Goldberg, 2005; Ceglowski, 2010). The shift could happen across the product categories within and across the trading partners, putting upward or downward pressure on the competition. A heightened (lessened) competition may discourage (encourages) firms to pass the change of the exchange rate onto

the price, leading to a decline (rise) in ERPT. Tables 6 and 7 show Japanese sectoral import shares over bilateral imports and total sectoral imports for the three major trading partners.

Table 6. Japanese Sectoral Import Shares Over Bilateral Import (in percent)

	1990	1995	2000	2005	2010
EU					
Manufactures	12.8	11.3	9.3	9.0	7.6
Non-manufactures	84.6	86.6	89.0	89.7	91.6
Food, Live Animals, Beverage, Tobacco	8.9	9.3	9.8	9.4	11.5
Crude Materials, Animal and Vegetable Oils	2.4	3.2	3.4	3.5	3.3
Mineral Fuels	0.5	0.1	0.1	0.2	0.4
Chemicals	14.8	19.3	21.6	24.1	31.5
Machinery and Transport Equipment	33.0	36.7	37.7	36.0	31.1
Miscellaneous Articles	24.9	18.0	16.5	16.5	13.9
Asian NIEs					
Manufactures	17.5	13.9	9.8	13.0	14.2
Non-Manufactures	79.7	83.7	87.1	80.4	76.7
Food, Live Animals, Beverage, Tobacco	15.2	13.3	6.7	5.3	5.3
Crude Materials, Animal and Vegetable Oils	3.8	2.5	1.7	2.0	2.9
Mineral Fuels	7.5	3.8	8.0	7.2	6.9
Chemicals	5.3	4.8	6.0	9.3	11.4
Machinery and Transport Equipment	19.1	40.3	52.6	46.3	41.5
Miscellaneous Articles	28.7	18.9	12.2	10.4	8.7
Us					
Manufactures	9.5	7.4	5.9	5.6	5.5
Non-Manufactures	88.4	90.5	91.8	92.0	91.9
Food, Live Animals, Beverage, Tobacco	20.2	21.1	19.2	20.7	21.2
Crude Materials, Animal and Vegetable Oils	14.8	10.6	5.9	5.5	6.2
Mineral Fuels	3.1	1.7	1.5	1.9	2.9
Chemicals	9.8	9.4	10.1	12.5	17.9
Machinery and Transport Equipment	32.3	38.1	44.3	41.0	34.3
Miscellaneous Articles	8.2	9.6	10.8	10.3	9.5

Note: Author's calculation based on data from Ministry of Finance Japan.

Table 7. Japanese Sectoral Import Shares Over Total Sectoral Imports

	1990	1995	2000	2005	2010
EU					
Manufactures	14.5	13.4	11.9	10.8	8.2
Non-manufactures	15.1	14.7	12.4	11.5	9.8
Food, live animals, beverage, tobacco	9.9	8.9	9.9	11.0	12.8
Crude materials, animal and vegetable oils	3.0	4.7	6.4	6.4	4.0
Mineral fuels	0.3	0.1	0.1	0.1	0.1
Chemicals	32.4	38.3	38.1	36.1	34.1
Machinery and transport equipment	30.6	22.9	16.1	15.4	12.4
Miscellaneous articles	32.3	18.5	14.5	14.4	11.8
Asian NIEs					
Manufactures	14.6	13.9	12.5	13.5	14.2
Non-manufactures	10.5	12.0	12.0	8.9	7.6
Food, live animals, beverage, tobacco	12.4	10.8	6.7	5.3	5.5
Crude materials, animal and vegetable oils	3.4	3.1	3.1	3.1	3.3
Mineral fuels	3.5	3.0	4.8	2.8	2.1
Chemicals	8.6	8.0	10.5	12.1	11.4
Machinery and transport equipment	13.1	21.3	22.3	17.1	15.3
Miscellaneous articles	27.5	16.4	10.7	7.9	6.8
US					
Manufactures	16.1	13.5	11.6	7.4	6.1
Non-manufactures	23.5	23.7	19.7	12.9	10.0
Food, live animals, beverage, tobacco	33.5	31.2	30.1	26.4	24.1
Crude materials, animal and vegetable oils	27.1	24.3	17.3	11.2	7.7
Mineral fuels	2.9	2.5	1.4	0.9	1.0
Chemicals	32.1	28.7	27.4	20.5	19.7
Machinery and transport equipment	44.8	36.8	29.3	19.2	13.9
Miscellaneous articles	15.9	15.2	14.6	9.8	8.1

Note: Author's calculation based on data from Ministry of Finance Japan.

Our early results show that the ERPT for manufactures is stable over time. This could be due to its small import share compared to non-manufactures and the shares do not change much over the decades. The manufacturing imports into Japan accounted for only roughly 10 percent of total bilateral imports for the EU and US and slightly higher for Asian NIEs, and these shares fell slightly and proportionally (Table 6). Moreover, Table 7 shows that these countries possessed a roughly similar market share in Japan, although, over the decades, the US share seemed to fall much faster while Asian NIEs still maintained their share at about 14 percent.

For the non-manufacture imports from the EU, there was a large shift in the import composition. Notably, food import share rose gradually from about 9 percent in 1990 to about 12 percent in 2010, chemical import share rose to about 30 percent from 15 percent while that of miscellaneous articles fell to 14 percent from 25 percent over the same period (Table 6). Additionally, the market share of food imports from the EU also slightly rises from about 10 to almost 13 percent in 2010 while that from

Asian NIEs and the US fell over the same period (Table 7). This evidence is consistent with our earlier empirical finding that the ERPT for food imports from the EU is rising. Also, the decline in the ERPT for food import from the Asian NIEs is consistent with the decreased food imports from this region while the rise in the ERPT for food import from the US is consistent with the rise in food imports from the US.

However, as for chemicals, among the three trading partners, the EU maintained its import market share for chemicals above 30 percent while the US chemical imports fell from 32 percent in 1990 to slightly below 20 percent in 2010. This seems to go against the direction of declining the pass-through suggested by earlier empirical studies. This could be because the gradual rise in the chemical import share from Asian NIEs could put downward pressure on competition, raising its ERPT and driving down the ERPT for chemical imports from the EU.

CONCLUSION

In this paper, we have examined the changes in exchange rate pass-through to the Japanese import prices from the U.S, the EU, and Asian newly industrialized economies (NIEs--Hong Kong, Korea, Singapore, and Taiwan) between 1998:01 and 2010:12 over manufactured, total product level and seven product categories, namely foods, raw materials, fuels, apparel, chemicals, metals, and machinery. We investigated whether the stability of pass-through has varied by source country. The paper finds evidence of a declining long-run pass-through rate for some sectors and increasing pass-through for others for the countries in our sample.

First, we find cases of a contrasting trend of exchange rate pass-through relative to earlier studies. This study starts from 1998 to 2010, the period known as the lost decade in the Japanese economy when its exchange rate was on a gradual appreciation, while earlier studies examine the pass-through from the 1980s through the late 1990s or early 2000s. More specifically, our evidence of an upward trend in exchange rate pass-through occurs after 2000 and later. Second, although the Japanese bilateral exchange rate pass-through to import prices from US and Asian NIEs increases in some sectors, we find no evidence of the changes in exchange rate pass-through at the overall level for each of these partners. The findings in this paper should inform the Japanese policymakers on their exchange rate policy and, more specifically, how the exchange rate changes affect product-level import prices in both the short and long run.

REFERENCES

Amiti, M., Itskhoki, O. & Konings, J. (2014). Importers, Exporters, and Exchange Rate Disconnect., *American Economic Review*, vol. 104, 1942-78.

Brun-Aguerre, R., Fuertes, A.-M., & Greenwood-Nimmo, M. (2016). Heads I win; tails you lose: asymmetry in exchange rate pass-through into import prices., *Journal of the Royal Statistical Society*., Series. A. Stat. Soc. https://doi.org/10.1111/rssa.12213.

Bussière, M., Chiaie, S. D., & Peltonen, T. A. (2014). Exchange rate pass-through in the global economy: The role of emerging market economies., *IMF Economic Review*, vol. 62, 146–178.

Campa, J. M, & Goldberg, L. S. (2005). Exchange Rate Pass-Through into Import Prices., *Review of Economics and Statistics*, vol. 87, 679-690.

Ceglowski, J. (2010). Exchange Rate Pass-Through to Bilateral Import Prices., *Journal of International Money and Finance*, vol. 29(8), 1637-1651.

Ceglowski, J. (2010). Has Pass-Through to Export Prices Risen? Evidence for Japan., *Journal of the Japanese and International Economies*, vol. 24, 86–98.

Chang, J. C. & Tsong, C-C. (2010). Exchange Rate Pass-Through and Monetary Policy: A Cross-Commodity Analysis., *Emerging Markets Finance and Trade,* vol. 46, 106–120.

Civcir, I., & Akçağlayan, A. (2010). Inflation targeting and the exchange rate: Does it matter in Turkey?, *Journal of Policy Modeling*, vol. 32, 339–354.

Delatte, A-L, & Lopez-Villavicencio, A. (2012). Asymmetric exchange rate pass-through: evidence from major countries., *Journal of Macroeconomics*, vol. 34, 833–44.

Gaulier, G., Lahreche-Revil, A. & Mejean, I. (2008). Exchange-Rate Pass-Through at the Product Level. Canadian, *Journal of Economics*, vol. 41, 425-449.

Ghosh, A., & Rajan, R. (2009). What is the extent of exchange rate pass-through in Singapore? Has it changed over time?, *Journal of the Asia Pacific Economy*, vol. 14, 61-72.

Goldberg, P. K., & Knetter, M. M. (1997). Goods Prices and Exchange Rates: What Have We Learned?, *Journal of Economic Literature*, vol. 35, 1243-1272.

Goldberg, L. & Campa, J. (2010). The sensitivity of CPI to exchange rates: Distribution margins, imported inputs and trade exposure., *Review of Economics and Statistics*, vol. 92, 392- 407.

Hellerstein, R., Daly, D., & Marsh, C. (2006). Have US import prices become less responsive to changes in the dollar?, *Current Issues in Economics and Finance*, 12 (6), 1-7.

Ihrig, J. E., Marazzi, M. & Rothenberg, A.D. (2006). Exchange-rate Pass-Through in the G-7 Countries., *International Finance Discussion Paper*, no. 856, Washington, DC.

Jimborean, R. (2013). The exchange rate pass-through in the new EU member states, *Economic Systems*, vol. 37, 302-329.

Jiménez-Rodríguez, R., & Morales-Zumaquero, A. (2016). A new look at exchange rate pass through in the G-7 countries., *Journal of Policy Modeling*, vol. 38, 985-1000.

Kassi, D. F., Sun, G., Ding, N., Rathnayake, D. N., & Assamoi, G. R. (2018). Asymmetry in exchange rate pass-through to consumer prices: Evidence from emerging and developing Asian countries., *Economic Analysis and Policy,* vol. 62, June 2019, 357-372, doi:10.1016/j.eap.2018.09.013.

Malenbaum, M. (2019). China's impact on pass-through to US import prices., *Journal of Chinese Economic and Foreign Trade Studies*, vol. 12, 55-72.

Marazzi, M., Sheets, N., Vigfusson, R., Faust, J., Gagnon, J., Marquez, J., Martin, R., Reeve, T., & Rogers, J. (2005). Exchange Rate Pass-through to US Import Prices: Some New Evidence., *International Finance Discussion Paper,* No. 833. Washington, DC.

Mumtaz, H., Oomen, O., & Wang, J. (2006). Exchange Rate Pass-Through into UK Import Prices: Evidence from Disaggregated Data. *Bank of England, Working Paper* No. 312.

Shintani, M., Terada-Hagiwara, A., & Yabu, T. (2013). Exchange rate pass-through and inflation: A nonlinear time series analysis., *Journal of International Money and Finance*, vol. 32, 512-527.

Olivei, G., (2002). Exchange Rates and the Prices of Manufacturing Products Imported into the United States., *New England Economic Review*, Q1: 4-18.

Otani, A., Shiratsuka, S. & Shirota, T. (2003). The Decline in the Exchange Rate Pass-Through: Evidence Japanese Import Prices., *Monetary and Economic Studies*, vol. 21, 53-81.

Otani, A., Shiratsuka, S., and Shirota, T. 2005. "Revisiting the Decline in the Exchange-Rate Pass-Through: Further Evidence from Japan's Import Prices." *IMES Discussion Paper* No. 2005-E-6, Bank of Japan.

Phuc, N. & Duc, V.H. (2021). Macroeconomics Determinants of Exchange Rate Pass-Through: New Evidence from the Asia-Pacific Region., *Emerging Markets Finance and Trade*, vol.57(1), 5-20. https://doi.org/10.1080/1540496X.2018.1534682

Steel, D., & King, A. (2004). Exchange rate pass-through: The role of regime changes., *International Review of Applied Economics*, vol.18, 301-322.

Yanamandra, V. (2015). Exchange rate changes and inflation in India: What is the extent of ERPT to imports., *Economic Analysis and Policy*, vol.47, 57–68.

_____

APPENDIX

DATA SOURCES AND DEFINITIONS

	Locality	Description	Sources
Japanese Domestic Economic Activity	*Japan*	*Total industrial production, seasonally adjusted, 2000=100*	*IFS CD-ROM, 2011*
Japanese Bilateral Import Prices	*US* *Asian NIEs* *The EU*	*Unit value of bilateral imports*	*Ministry of Finance Japan;* *http://www.customs.go.jp/toukei/srch/indexe.htm?M=59&P=0*
Exchange Rate	*US* *Asian NIES*	*Monthly average rate with respect to Yen* *Trade-weighted geometric average of monthly average exchange rates with respect to Yen with normalized weights determined by each country's share of Japan imports in 2002*	*Pacific Exchange Rate Service http://fx.sauder.ubc.ca.*
	The EU	*Trade-weighted geometric average of monthly average of the euro/ECU, UK pound, Danish kroner, and Swedish kroner against Yen*	*Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/exchange_rates/data/database* *Pacific Exchange Rate Service http://fx.sauder.ubc.ca.*
Foreign Cost	*Asian NIEs*	*Producer or wholesale price index for Korea, and Singapore* *Consumer price index for Hong Kong*	*IFS CD-ROM, 2011*
		Producer or wholesale price index for Taiwan	*Republic of China, Directorate General of Budget, Accounting, and Statics http://www.dgbas.gov.tw*
	The EU	*Producer price index, Manufacturing, EU 15, 2000=100*	*OECD main economic indicators online*
	US	*Producer price index, 2000=100*	*IFS CD-ROM, 2011*