Revisiting the Decline in the Exchange Rate Pass-Through: Further Evidence from Japan's Import Prices

Akira Otani, Shigenori Shiratsuka, and Toyoichiro Shirota

Many empirical studies show common empirical findings that the exchange rate pass-through to import prices in advanced countries declined in the 1990s. Some of those studies, however, draw contrasting conclusions regarding the factors behind the decline. Campa and Goldberg (2002) point out that it comes mainly from the decrease in the import share of primary commodities, such as raw materials and fuels, while Otani, Shiratsuka, and Shirota (2003) make the case that it is mostly attributable to the decline in the exchange rate pass-through in each product category. In this paper, we empirically reexamine the validity of the contrasting hypotheses. Our empirical results demonstrate that the decline in the exchange rate pass-through to Japan's import prices excluding primary commodities is largely attributable to the decreases in the exchange rate pass-through in each product. Our empirical results also suggest the possibility that the declines in the long-term exchange rate pass-through to overall import prices are induced partly by the reduction in the import share of primary commodities. The second point, however, should be taken cautiously, because the precision of the estimates is not high enough to draw a definite conclusion.

Keywords: Exchange rate pass-through; Pricing-to-market; Import structure; Expenditure-switching effect; Firms' sourcing decision
JEL Classification: F21, F30, F40

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We thank Shin-ichi Fukuda, Eiji Ogawa, Yuri Sasaki, and Shinji Takagi, participants at the 2004 Tokyo Center for Economic Research Zushi Conference, and the staff of the Institute for Monetary and Economic Studies of the Bank of Japan (BOJ) for their useful comments. We also thank Masayuki Nakakuki and Hiroyuki Oi for their assistance. The views expressed in this paper are those of the authors and do not necessarily reflect the official views of the BOJ.

I. Introduction

Recently theoretical as well as empirical research on the exchange rate pass-through has attracted renewed attention. This line of research focuses on the exchange rate pass-through to import prices measured by "aggregate" price indicators, rather than export price setting by individual exporters in previous studies. In addition, recent studies have attempted to derive some policy implications from the exchange rate pass-through on future price developments in the economy as a whole.

Otani, Shiratsuka, and Shirota (2003) indicate two factors behind the renewed interest in the exchange rate pass-through. The first is Taylor's (2000) conjecture on the recent worldwide decline in the exchange rate pass-through. His conjecture suggests that it becomes increasingly difficult for firms to fully pass on exchange rate movements in their export prices in the context of the recent economic environment, characterized by intensified worldwide competitive pressure and low and stable inflation. In response, the policy implications of the declines in the exchange rate pass-through to domestic prices are widely discussed. Taylor's conjecture provides an important implication for future price developments. As long as low and stable inflation is maintained, the exchange rate pass-through remains low, and inflation, in turn, continues to stay at a very low and stable level. This implies that a virtuous circle exists between price developments and corporate pricing behavior. This circle, however, is vulnerable to accelerating inflation, if inflation increases in response to an external shock, and thus, the exchange rate pass-through also increases.

The second factor is the recent theoretical development of "new open-economy macroeconomics," starting from Obstfeld and Rogoff (1995).[1] Since this line of research has micro foundations, exporters can decide to set their export prices in their currency (producers' currency pricing [PCP]) or in the consumers' currency (local currency pricing [LCP]) in the models. In the PCP model, the exchange rate pass-through on import prices is always perfect, and thus exchange rate fluctuations work to adjust the current account imbalance and business cycle.[2] In the case of LCP, however, the exchange rate pass-through is limited, thus producing only a small expenditure switching effect between domestic and foreign goods.[3] As such, these studies show that the difference in firms' price-setting behavior significantly influences the transmission of monetary policy by changing the degree of the exchange rate pass-through.

Following the aforementioned theoretical developments, a number of empirical studies on the exchange rate pass-through to import prices have been carried out.[4] For example, Campa and Goldberg (2002) estimate the exchange rate pass-through

1. See Lane (2001) for a survey of recent developments in "new open-economy macroeconomics."
2. Many of these models assume that exporting firms directly sell their products to consumers in the importing country, and that import prices are equal to consumer prices. This is equivalent to assuming that home inputs are not used for the sales activity of imported goods. In reality, however, domestic inputs are necessary for the sales activity of imported goods. Thus, both import prices of goods and domestic input prices of sales activity influence the retail prices consumers face. As a result, the exchange rate pass-through on import prices is generally higher than that on consumer price index (CPI)-based prices.
3. Research includes Betts and Devereux (2000) and Otani (2002).
4. A considerable number of theoretical models on the exchange rate pass-through on firms' export prices were proposed in the late 1980s. They focus on microeconomic aspects such as the shape of the demand curve and cost

to the import prices for 25 member countries of the Organisation for Economic Co-operation and Development (OECD), and show that the exchange rate pass-through to import prices declined significantly in the 1990s. In addition, Otani, Shiratsuka, and Shirota (2003) examine the exchange rate pass-through to import prices in Japan, and show that it also continued to decline in the 1990s.[5]

Campa and Goldberg (2002) and Otani, Shiratsuka, and Shirota (2003), however, draw contrasting conclusions regarding the factors behind the worldwide decline in the exchange rate pass-through. The former state that it comes mainly from the decline in the import share of primary commodities such as raw materials and fuels. The latter argue that it is mostly attributable to the decline in the exchange rate pass-through for each product.

In this paper, following Otani, Shiratsuka, and Shirota (2003), we estimate the exchange rate pass-through to import prices using both import prices including and excluding the effects of primary commodity prices. We thereby carry out a rigorous reexamination of the validity of the contrasting hypotheses on the decline in the exchange rate pass-through proposed by Campa and Goldberg (2002) and Otani, Shiratsuka, and Shirota (2003).[6]

Our empirical evidence suggests two points regarding the factors behind the decline in the exchange rate pass-through to import prices in Japan in the 1990s. First, the decline in the long-term exchange rate pass-through to import prices excluding primary commodities is largely attributable to the declines in the long-term pass-through to category import prices, such as general machinery and equipment and electrical machinery and equipment. Second, the decline in the long-term exchange rate pass-through to overall import prices including primary commodities is possibly induced by the decline in the import share of primary commodities. The second point, however, should be taken cautiously, because the precision of the estimates is not high enough to draw a definite conclusion.

This paper is structured as follows. Section II explains the basic specifications and data used in our estimation of the exchange rate pass-through to import prices. Section III shows our estimation results by comparing the previous studies. Finally, Section IV summarizes the findings of this paper and examines the implication of recent changes in the exchange rate pass-through for monetary policy.

function, or the existence of irreversible investment (sunk cost). Following the development of these theoretical studies, from the end of the 1980s through the 1990s, a large number of empirical studies estimated the exchange rate pass-through using micro data on firms' export prices. Recently, some researchers have built structural models of industry behavior based on the industrial organization theory to estimate the exchange rate pass-through to export prices using micro data. For example, Kadiyali (1997) and Hellerstein (2002) estimate the exchange rate pass-through of the film industry and the beer industry, respectively.

5. In addition, some studies estimate the exchange rate pass-through to import prices in Japan. Fujii (2004), for example, shows empirical evidence that Japan's exchange rate pass-through declined significantly in the 1990s, similar to what is shown by Otani, Shiratsuka, and Shirota (2003).

6. Following the empirical framework of Otani, Shiratsuka, and Shirota (2003), we carry out our analysis with emphasis on the robustness of data and empirical procedures. First, we use the import price series in the corporate goods price index (CGPI). Since the CGPI adjusts to changes in product quality over time, this enables us to exclude the "spurious" changes in the exchange rate pass-through, possibly caused by the shift in average product quality in response to exchange rate fluctuations. Second, we apply a specification that is simple but flexible enough to capture the exact long-term impacts of exchange rate fluctuations on import prices. In addition, this specification enables us to employ rolling regression analysis to explore in detail when and by how much the long-term exchange rate pass-through has declined since the 1980s.

II. Specifications and Data

In this section, we show the empirical framework to estimate the exchange rate pass-through to import prices both excluding and including effects of primary commodities in a more rigorous manner. We basically follow the empirical specification in Otani, Shiratsuka, and Shirota (2003), except that we use the effective exchange rate, the nominal effective exchange rate deflated by the overall corporate goods price index (CGPI), as a foreign exchange rate variable, instead of the nominal effective exchange rates in Otani, Shiratsuka, and Shirota (2003).

We use monthly data to estimate the exchange rate pass-through based on equation (1) below, which includes a partial adjustment term to import prices to allow for the possibility of gradual adjustment of import prices to exchange rate fluctuations.[7]

$$\Delta imp_t^i = \phi^i + \varphi^i \Delta imp_{t-1}^i + \gamma^i \Delta eer_t^i + \eta^i \Delta z_t^i + v_t^i,$$

$$\lambda^i = \gamma^i/(1-\varphi^i), \qquad (1)$$

where Δimp_t, Δeer_t, and Δz_t are the increments of import prices, the effective exchange rate, and other control variables that are specified below, respectively, and superscript i denotes product categories. γ and λ represent the short-term and long-term pass-through, respectively.[8] Note that this specification enables us to obtain the total effect of the current exchange rate on the current and future import prices, that is, the exact long-term pass-through of the current exchange rate.

Data used in our estimation are as follows. First, for the dependent variable of import prices, we employ import price indexes for each product category from the CGPI. In addition, we compile an additional series that excludes the import price index for primary commodities from overall import prices. To decompose changes in the exchange rate pass-through to overall import prices excluding primary commodities, we also compile import price indexes for major product categories excluding primary commodities. We use subgroup indexes of machinery and equipment: general machinery and equipment, electrical machinery and equipment, and transportation equipment. In sum, we estimate the exchange rate pass-through using the aggregate series and disaggregated import prices for eight categories: foodstuffs and feedstuffs, textiles, metals and related products, chemicals and related products, general machinery and equipment, electrical machinery and equipment, transportation equipment, and others.[9]

7. We do not use an error correction model (ECM) in this paper, since the existence of cointegration between the exchange rate and import prices is rejected by the Engle-Granger test.
8. Estimates of the short-term pass-through in Campa and Goldberg (2002) are quarterly, while ours are monthly. The long-term pass-through in equation (1) is a nonlinear function of estimated coefficients. Accordingly, the standard error of the long-term pass-through (σ_λ) is estimated as follows.

$$\sigma_\lambda = (\lambda_\gamma^2 Var[\gamma] + \lambda_\varphi^2 Var[\varphi] + 2\lambda_\gamma \lambda_\varphi Cov[\gamma, \varphi])^{1/2},$$

where $Var[\cdot]$, $Cov[\cdot]$, λ_γ, and λ_φ are estimated variance, estimated covariance, $\partial\lambda/\partial\gamma(= 1/(1-\varphi))$, and $\partial\lambda/\partial\varphi$ $(= \gamma/(1-\varphi)^2)$, respectively.
9. We use an original series of group indexes for chemicals, and subgroup indexes in the machinery and equipment group for general, electrical, and transportation equipment. We make adjustments to exclude primary commodities

Second, for the independent variables, we use the effective exchange rates, which are the effective nominal exchange rates of the International Monetary Fund (IMF) deflated by the domestic CGPI.[10] In addition, we adopt demand shock and marginal cost changes as in Campa and Goldberg (2002). We employ the index of industrial production (IIP) as a proxy for demand shock. We calculate the marginal cost according to the following formula used in Campa and Goldberg (2002):

$$MC = (NER^{JPN}/RER^{JPN}) \cdot ULC^{JPN},$$

where *MC*, *NER*, *RER*, and *ULC* denote the marginal cost, the nominal effective exchange rate, the real effective exchange rate, and the unit labor cost, respectively, in *Main Economic Indicators* (MEI). The superscript *JPN* refers to Japan. Since the IMF's real effective exchange rate is deflated by the unit labor cost of trading partners, the calculated marginal cost obtained by the above formula becomes a weighted average of unit labor cost in trading partner countries.

In estimating the exchange rate pass-through based on equation (1) using the aforementioned data, we adopt seemingly unrelated regression (SUR) to improve the efficiency, utilizing the residual correlation among the equations of each product category.[11]

III. Estimation Results

In this section, we estimate the exchange rate pass-through to import prices by excluding and including the impacts of primary commodity prices, based on the empirical procedures summarized in the previous section. We then examine the validity of the two contrasting hypotheses on the decline in the exchange rate pass-through: the lower import share of primary commodities and the decline in the pass-through to each category import prices. We also carry out a rolling regression to detect the timing and causes of the decline in the long-term exchange rate pass-through from the 1980s.

by using disaggregated series for foodstuffs and feedstuffs, textiles, metals and related products, and others. More precisely, we make adjustments for the 2000-year base import price index.

Foodstuffs and feedstuffs: Foodstuffs and feedstuffs (Group) − Edible agriculture, livestock and fishery products (Subgroup) − Feedstuffs (Subgroup).

Textiles: Textiles (Group) − Natural fiber materials (Subgroup).

Metals and related products: Metals and related products (Group) − Metal materials (Subgroup) − Nonferrous metals (Subgroup).

Others: Other primary products and manufactured goods (Group) − Inedible agriculture and fishery products (Subgroup) − Nonmetallic minerals (Subgroup) − Pulp (Commodity class) Wastepaper (Commodity) + Processed lumber products (Subgroup) + Wood products (Subgroup) + Precision instruments (Subgroup).

We also make adjustments to the import price indexes for the base year prior to 2000 in a manner similar to that in the 2000-year base index above.

10. Expressed in yen terms.
11. The estimations are conducted using the logarithmic first difference of variables to control for the possibility of unit roots in variables included in estimation equations. The results of the augmented Dickey-Fuller test for variables included in the estimated equations reject the existence of the unit root in the first difference, but do not reject them in terms of the level.

A. Benchmark Estimation Results

We first examine whether the decline in the pass-through to overall import prices comes from the import structure changes, as is suggested by Campa and Goldberg (2002). Table 1 summarizes the short-term and long-term pass-through coefficients of overall import prices, overall import prices excluding primary commodities, and import prices of product categories. The sample periods are divided into the periods before and after 1990.

Looking at the full-sample estimation results in the first column in Table 1, pass-through coefficients for overall import prices in the short term and long term are 0.59 and 0.90, respectively, confirming that the pass-through coefficient is larger by 0.31 in the long term than in the short term.[12] The short-term pass-through

Table 1 Exchange Rate Pass-Through: Benchmark Estimation Results

	Jan. 1980–Dec. 2003	Jan. 1980–Dec. 1989 (a)	Jan. 1990–Dec. 2003 (b)	(b) – (a)
[1] Short-Term Pass-Through				
(OLS estimation)				
Overall	0.59 (0.04)	0.73 (0.07)	0.53 (0.04)	–0.21 [0.00]
Overall, excluding primary commodities	0.53 (0.02)	0.55 (0.03)	0.54 (0.02)	–0.01 [0.00]
(SUR estimation)				
Foodstuffs and feedstuffs	0.56 (0.03)	0.57 (0.07)	0.56 (0.03)	–0.02 [0.99]
Textiles	0.37 (0.02)	0.30 (0.05)	0.43 (0.02)	0.13 [0.01]
Metals and related products	0.40 (0.04)	0.60 (0.08)	0.29 (0.03)	–0.31 [0.00]
Chemicals and related products	0.50 (0.04)	0.66 (0.06)	0.41 (0.05)	–0.24 [0.10]
General machinery and equipment	0.68 (0.02)	0.67 (0.05)	0.69 (0.02)	0.02 [0.00]
Electrical machinery and equipment	0.61 (0.03)	0.74 (0.06)	0.56 (0.04)	–0.18 [0.00]
Transportation equipment	0.47 (0.03)	0.39 (0.07)	0.54 (0.03)	0.15 [0.00]
Others	0.56 (0.02)	0.42 (0.03)	0.64 (0.02)	0.22 [0.00]
[2] Long-Term Pass-Through				
(OLS estimation)				
Overall	0.90 (0.07)	1.28 (0.16)	0.67 (0.06)	–0.61 [0.00]
Overall, excluding primary commodities	0.65 (0.03)	0.75 (0.06)	0.59 (0.02)	–0.16 [0.00]
(SUR estimation)				
Foodstuffs and feedstuffs	0.69 (0.05)	0.68 (0.10)	0.69 (0.05)	0.01 [0.99]
Textiles	0.53 (0.04)	0.49 (0.10)	0.54 (0.03)	0.05 [0.01]
Metals and related products	0.52 (0.05)	0.78 (0.12)	0.34 (0.04)	–0.44 [0.00]
Chemicals and related products	0.74 (0.07)	0.94 (0.11)	0.62 (0.09)	–0.32 [0.10]
General machinery and equipment	0.84 (0.04)	0.98 (0.09)	0.77 (0.03)	–0.20 [0.00]
Electrical machinery and equipment	0.70 (0.04)	0.90 (0.09)	0.60 (0.04)	–0.30 [0.00]
Transportation equipment	0.58 (0.05)	0.58 (0.12)	0.56 (0.03)	–0.02 [0.00]
Others	0.63 (0.03)	0.50 (0.05)	0.70 (0.03)	0.20 [0.00]

Note: Figures in parentheses are standard errors. Figures in brackets are *p*-values for the *F*-test on the null hypothesis that estimates in columns (a) and (b) are identical.

12. The estimates are a little smaller than those in Campa and Goldberg (2002). One reason is the difference in the frequency of data used in estimations: we employ monthly data, while they employ quarterly data. Another reason is the difference in sample periods: we use a longer time series, ranging up until December 2003.

coefficients are almost the same regardless of whether they include or exclude primary commodities: overall, 0.59; and overall, excluding primary commodities, 0.53. In contrast, the long-term coefficients become low if primary commodities are excluded: overall, 0.90; and overall, excluding primary commodities, 0.65.

The estimates are higher in long-term coefficients than short-term coefficients in all the product categories, although they differ across product categories. Looking at short-term coefficients, general machinery and equipment and electrical machinery and equipment show high estimates at 0.68 and 0.61, respectively, while textiles are the lowest at 0.37. The other categories, such as metals and related products, and chemicals and related products, fall between these high and low benchmarks. As for long-term coefficients, chemicals and related products, general machinery and equipment, and electrical machinery and equipment show higher estimates of 0.74, 0.84, and 0.70, respectively, while textiles and metals and related products show lower estimates of 0.53 and 0.52, respectively. Foodstuffs and feedstuffs, transportation equipment, and others exhibit estimates toward the middle of the range at 0.69, 0.58, and 0.63, respectively.

Comparing the estimates between the two subsample periods before and after 1990, declines in the pass-through coefficients are observed for overall import prices, both including and excluding primary commodities, for both the short and long term. The pass-through coefficient declines much more in the long term than in the short term, and overall than overall, excluding primary commodities.[13] Among product categories, metals and related products, chemicals and related products, and electrical machinery and equipment exhibit large declines in short-term estimates. In addition to the above three, more product categories, such as general machinery and equipment and transportation equipment, show declines in long-term estimates.

It should be noted, however, that the estimates for overall import prices including primary commodity prices are not necessarily precise for the 1980s, as both foreign exchange rates and primary commodity prices, including crude oil prices, show tremendous fluctuations. Although in theory the estimates for the long-term pass-through stay between zero and one, our estimate for overall import prices for the 1980s is far higher than one. In addition, its standard error is larger than overall, excluding primary commodities for the 1980s and overall, including primary commodities for the 1990s.[14]

As a reason for the low precision of the estimates for import prices including primary commodities, it is pointed out that the specification of equation (1) does not fully incorporate the effects of changes in exporter countries' costs. In particular, it is likely that our estimates are relatively sensitive to the large fluctuations of exchange rates and commodity prices, including crude oil, in the 1980s, due to the limitation in the specification. The point estimates in Campa and Goldberg (2002) also exceed one, suggesting that a similar problem affects their estimates of the pass-through.

13. The decline in the long-term pass-through after the 1980s is larger than that in the short-term pass-through. This is because partial adjustment parameter β declines, suggesting that import prices have become less sticky recently than they were in the 1980s.
14. In fact, the estimate of the long-term exchange rate pass-through to overall import prices is 1.28. Even though it is far larger than one, it cannot be said that it differs from one in a statistically significant sense because of the large standard error.

Based on the consideration above, it is deemed difficult to quantitatively examine which factor has more dominant effects on the decline in the pass-through to overall import prices in the 1990s: the decline in the import share of primary commodities or the decline in the pass-through for each product category. It is undeniable in a qualitative sense that the decline in the import share of primary commodities reduces the pass-through to import prices including primary commodities.[15] At the same time, it is difficult to estimate the pass-through coefficients with the precision necessary to make a qualitative evaluation.

We then focus our attention on import prices excluding primary commodities to examine the factors behind the decline in the pass-through in a rigorous manner. More precisely, we decompose the decline in the pass-through to overall import prices excluding primary commodities into the contributions of changes in the import share and those in the pass-through to each product category. Given that the pass-through to overall import prices roughly corresponds to the weighted average of the pass-through to each category of products, $\bar{\gamma}_t$, we can express the changes in the pass-through from period 0 to period t below:[16]

$$\bar{\gamma}_t - \bar{\gamma}_0 = \sum_i w_t^i \gamma_t^i - \sum_i w_0^i \gamma_0^i$$

$$= \sum_i w_t^i (\gamma_t^i - \gamma_0^i) + \sum_i (w_t^i - w_0^i)(\gamma_0^i - \bar{\gamma}_0), \qquad (2)$$

where w_t^i represents import share of product i at period t.

Table 2 reports the decomposition results, and clearly demonstrates that the declines in the long-term pass-through to overall import prices excluding primary commodities are largely attributable to declines in the pass-through to category import prices. This result suggests that the declines in the pass-through to Japan's import prices are caused by the declines in the pass-through to category import prices, especially in electrical machinery and equipment and chemicals and related products, in addition to the declines in the import share of primary commodities, as pointed out in Campa and Goldberg (2002).

B. Robustness Checks

To check the robustness of the above estimation results, we estimate the exchange rate pass-through based on (1) a different specification of lag pattern than equation (1) and (2) alternative data series of the effective exchange rate.[17]

15. The decline in the exchange rate pass-through from the 1980s to the 1990s is larger in overall import prices than in overall import prices excluding primary commodities. This is consistent with the empirical evidence in Otani, Shiratsuka, and Shirota (2003) showing that the decline in the pass-through is larger in overall import prices than in overall import prices excluding fuel. These results indicate the possibility that the decline in the import share of primary commodities is attributable to the decline in the pass-through. Since primary commodities such as raw materials and fuel are traded in U.S. dollar-denominated prices, the pass-through to primary commodity prices is unlikely to change over time.
16. The deviation of the weighted averaged pass-through from the estimated pass-through is practically small enough to be ignored in the decomposition exercise.
17. In addition to these robustness checks, we estimate equation (1) by using the unit value indexes (UVI) of imports as an alternative import price series. Nevertheless, the results are almost the same as the results reported in this paper.

Table 2 Decomposition of Changes in the Long-Term Pass-Through between the 1980s and the 1990s

	Changes in the pass-through to overall import prices	Contributions of	
		Changes in import share	Changes in the pass-through to category import prices
(Long-term pass-through)			
Overall, excluding primary commodities	–0.16	–0.02	–0.13
(Contribution of each category)			
Foodstuffs and feedstuffs		0.00	0.00
Textiles		0.00	0.01
Metals and related products		0.00	–0.02
Chemicals and related products		–0.02	–0.04
General machinery and equipment		–0.01	–0.02
Electrical machinery and equipment		0.02	–0.08
Transportation equipment		0.00	0.00
Others		–0.02	0.03

Note: Sum of the contributions is not necessarily equal to changes in the estimated pass-through to overall import prices, because of approximation error.

First, as an alternative specification to equation (1), we employ a similar specification to Campa and Goldberg (2002), as follows:[18]

$$\Delta imp_t^i = \alpha^i + \sum_{s=0}^{5} \beta_s^i \Delta eer_{t-s}^i + \delta^i \Delta z_t^i + \epsilon_t^i, \qquad (3)$$

where the short-term pass-through of product category i is given by the estimated coefficient β_0^i and the long-term pass-through is given by the sum of coefficients of exchange rate terms. Equation (1) assumes that the impact of changes in the nominal effective exchange rate gradually decays in an exponential manner. In contrast, equation (3) allows for a more flexible pattern in the impact of contemporaneous and lagged changes in the exchange rate.

Second, we next estimate equation (1), which is the same specification as the benchmark estimation, by using nominal effective exchange rates for each product category with time-varying weight, based on import value from major trading partners. The IMF effective exchange rate is less likely to reflect changes in import composition due to its use of a fixed weight, despite its advantage of the availability of long time-series retroactive to January 1978. In computing the effective exchange rates for each product category with time-varying weight, we use the one-year average of monthly imports for the category from major trading partner countries as a weight.[19] In addition, we use the weighted average of trade partners' producer price

18. Campa and Goldberg (2002) add lags of foreign production cost terms to estimation equations. However, we only include a contemporaneous marginal cost term, because the coefficients of the lags of marginal cost are not significant.
19. Import value data are taken from *The Summary Report on Trade of Japan* by the Ministry of Finance. Major trading partners include 30 economies as follows: Australia, Austria, Belgium, Brazil, Canada, Chile, China,

indexes (PPI)[20] as a proxy for marginal cost rather than basing it on the IMF effective exchange rate in the benchmark estimation.

Table 3 summarizes the changes in the pass-through coefficients in both the short term and long term due to space limitations. It should be noted, however, that the

Table 3 Robustness Check: Changes in the Pass-Through from the 1980s to the 1990s

	Alternative specification	Alternative series of the effective exchange rate	Benchmark (same as Table 1)
[1] Short-Term Pass-Through			
(OLS estimation)			
Overall	–0.06 [0.02]	–0.10 [0.02]	–0.21 [0.00]
Overall, excluding primary commodities	–0.03 [0.02]	–0.00 [0.37]	–0.01 [0.00]
(SUR estimation)			
Foodstuffs and feedstuffs	–0.01 [0.92]	–0.03 [0.45]	–0.02 [0.99]
Textiles	0.16 [0.02]	0.14 [0.05]	0.13 [0.01]
Metals and related products	–0.17 [0.20]	–0.27 [0.00]	–0.31 [0.00]
Chemicals and related products	–0.29 [0.03]	–0.21 [0.06]	–0.24 [0.10]
General machinery and equipment	0.11 [0.00]	0.06 [0.01]	0.02 [0.00]
Electrical machinery and equipment	–0.24 [0.00]	–0.12 [0.03]	–0.18 [0.00]
Transportation equipment	0.03 [0.00]	0.12 [0.02]	0.15 [0.00]
Others	0.22 [0.00]	0.24 [0.00]	0.22 [0.00]
[2] Long-Term Pass-Through			
(OLS estimation)			
Overall	–0.53 [0.02]	–0.39 [0.02]	–0.61 [0.00]
Overall, excluding primary commodities	–0.15 [0.02]	–0.08 [0.37]	–0.16 [0.00]
(SUR estimation)			
Foodstuffs and feedstuffs	0.12 [0.92]	0.04 [0.45]	0.01 [0.99]
Textiles	0.08 [0.02]	0.09 [0.05]	0.05 [0.01]
Metals and related products	–0.19 [0.20]	–0.37 [0.00]	–0.44 [0.00]
Chemicals and related products	–0.18 [0.03]	–0.24 [0.06]	–0.32 [0.10]
General machinery and equipment	–0.28 [0.00]	–0.07 [0.01]	–0.20 [0.00]
Electrical machinery and equipment	–0.46 [0.00]	–0.18 [0.03]	–0.30 [0.00]
Transportation equipment	–0.23 [0.00]	0.03 [0.02]	–0.02 [0.00]
Others	0.08 [0.00]	0.28 [0.00]	0.20 [0.00]

Notes: 1. Figures in the table are the difference in estimates for the former and latter subsample periods (January 1980–December 1989 and January 1990–December 2003).
2. Figures in brackets are *p*-values for the *F*-test on the null hypothesis that estimates of the two subsample periods are identical.

Denmark, Finland, France, Germany, India, Israel, Italy, Malaysia, Mexico, the Netherlands, Norway, Pakistan, the Philippines, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, the United Kingdom, the United States, and Venezuela. It should be noted that major trading partners do not include countries that export crude oil. This is due to concern over possible biases in the estimates for import prices excluding commodity prices if we use the IMF effective exchange rate, which includes exchange rates and import amounts between these economies. To check the robustness of our estimation results, we compute nominal effective exchange rates by adjusting the effects of oil imports, and estimate the pass-through to overall import prices, overall import prices excluding primary commodities, and category import prices excluding primary commodities.

20. We use the wholesale price index (WPI) when the PPI is not available. If the WPI is also not available, we use the CPI.

estimated coefficients are quite similar to the benchmark results, and are insensitive to changes in the specifications and the definition of effective exchange rates. First, the results using the alternative specification are quite closed to the benchmark estimation results, thus suggesting that our empirical results are robust to the changes in specifications. Second, the estimated declines in the pass-through become smaller when using alternative time series for effective exchange rates, while the qualitative conclusion remains unchanged.

C. Changes in the Pass-Through over Time

The above results for robustness checks suggest that our benchmark estimation results are not strongly influenced by the choices of specifications of lag pattern for exchange rates, or nominal effective exchange rate series. In the following, we examine changes in the pass-through coefficients over time by implementing a rolling estimation. In this exercise, we focus on the overall pass-through excluding fuels and materials to eliminate the impact of structural changes in imports.

Figure 1 summarizes the estimated coefficients of the exchange rate pass-through over time. The short-term pass-through in the upper panel is largely stable, though it exhibits a slight downward trend in the 1990s, and increases after the end-1990s. The long-term pass-through in the lower panel declines until the subsample period ending in 1998.

We also implement a rolling regression to all product categories to decompose the changes in pass-through coefficients of overall import prices excluding primary commodities into the contributions of changes in the import share and changes in the pass-through rate for each product category.

Figure 2 shows the decomposed result for the cumulative changes in the overall pass-through excluding primary commodities from 1986, based on equation (2). This figure indicates that the expansion of the cumulative decline in the overall pass-through excluding primary commodities is mostly attributable to declines in the pass-through to import prices for individual product categories.

Estimation results shown in this section are summarized as follows.

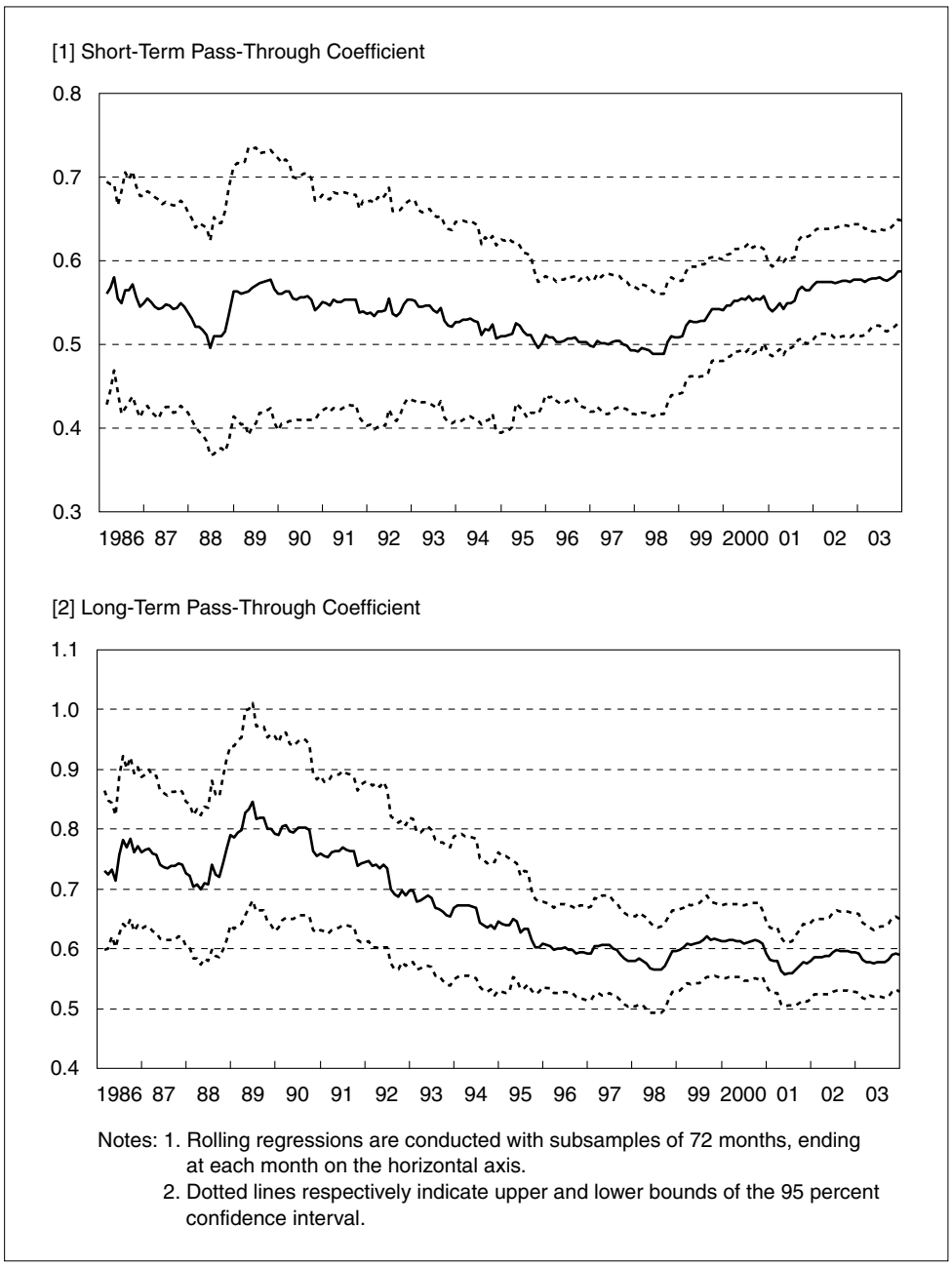
(1) The exchange rate pass-through declined after the 1980s.

(2) The declines in the overall pass-through are likely to be induced partly by declines in the import share of primary commodities, while its impacts are difficult to quantify in a rigorous manner.

(3) The declines in the long-term pass-through to overall import prices excluding primary commodities are largely attributable to the decrease in the pass-through to individual category import prices, such as general machinery and equipment and electrical machinery and equipment.

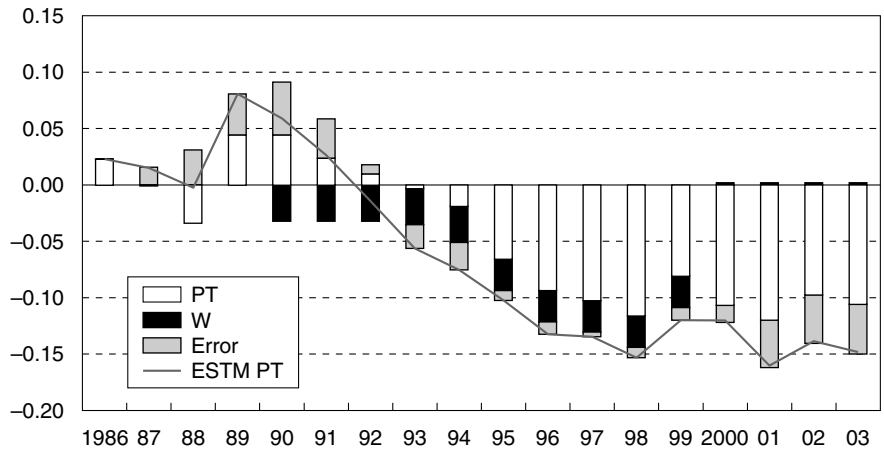
(4) The pass-through to overall import prices excluding primary commodities continued to decline in the 1990s, and leveled off thereafter.

Figure 1 Exchange Rate Pass-Through over Time (Overall, Excluding Primary Commodities/IMF Nominal Effective Exchange Rate)



Notes: 1. Rolling regressions are conducted with subsamples of 72 months, ending at each month on the horizontal axis.
2. Dotted lines respectively indicate upper and lower bounds of the 95 percent confidence interval.

Figure 2 Factor Decomposition: Cumulative Change in the Long-Term Exchange Rate Pass-Through (Overall, Excluding Primary Commodities)



Note: W: contribution of import composition changes to the cumulative changes in the pass-through; PT: cumulative change in the pass-through to each product category; error: estimated pass-through = W – PT; ESTM PT: estimated pass-through.

IV. Concluding Remarks

In this paper, we have examined the changes in the exchange rate pass-through on import prices in Japan using both time series for including and excluding primary commodities, following the empirical framework in Otani, Shiratsuka, and Shirota (2003). We have attempted to reexamine the contrasting hypotheses on the decline in the exchange rate pass-through given by Campa and Goldberg (2002) and Otani, Shiratsuka, and Shirota (2003).

Our empirical findings suggest two factors behind the decline in the long-term exchange rate pass-through. First, the declines in the long-term pass-through to overall import prices excluding primary commodities are largely attributable to the declines in the pass-through to individual category import prices, such as chemicals and related products, general machinery and equipment and electrical machinery and equipment. Second, although the declines in the overall pass-through are induced partly by declines in the import share of primary commodities, we failed to obtain estimation results that are high enough to carry out quantitative assessment in a rigorous manner.

Otani, Shiratsuka, and Shirota (2003) argue that the decline in the exchange rate pass-through to import prices in Japan is associated with the globalization of Japanese firms' activities, responding to the sharp appreciation of the yen in the mid-1980s. The foreign direct investment of Japanese firms has accelerated the globalization of their production bases. This in turn has raised the import penetration, thereby

bringing downward pressure on domestic prices in Japan.[21] Japanese firms have also increased their usage of the yen as an invoice currency for their imports. Although all of these movements most likely have lowered the exchange rate pass-through to Japan's import prices, empirical investigations using firm-level data are required to draw more decisive conclusions on this point.

It should be noted that the decline in the exchange rate pass-through does not necessarily imply that exchange rate fluctuations become less important in macroeconomic fluctuations. As Obstfeld (2002) points out, at least two factors can drastically modify the impact of exchange rate fluctuations on the economy in the conclusions of abstracted theoretical models. One is that the exchange rate pass-through to domestic prices is much slower than that to import prices, reflecting the complicated chain of transactions linking the two prices. The other is that the magnitude of the expenditure switching effect crucially depends on a firm's sourcing decisions across borders. In fact, it might be the case that the recent increase in intra-firm trading makes it possible to shift business activities across borders more smoothly, thereby enhancing the response to exchange rate changes.

21. Koike (2004), for example, empirically shows, based on the gravity model, that the foreign direct investment of Japanese firms has significant positive effects on trade between East Asian economies in the electrical machinery and textiles sectors.

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