Incomplete Exchange Rate Pass-Through and Goods Balance
— Marshall-Lerner Condition Revisited —

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Abstract

It is well known that an increase in the exchange rate (currency depreciation) improves the goods balance when the Marshall-Lerner condition is satisfied. This condition is derived under an implicit assumption that the change in the exchange rate is completely passed through into export prices as well as import prices. The literature, however, shows that the exchange rate pass-through is not complete. We examine the validity of the Marshall-Lerner condition theoretically and empirically in the case of incomplete exchange rate pass-through, and find that an increase in the exchange rate does not always improve the goods balance, even when the Marshall-Lerner condition is satisfied.

Key words : Marshall-Lerner condition, exchange rate pass-through, price elasticity, goods balance

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I. Introduction

Does an increase in a country's exchange rate (currency depreciation) improve the goods balance? To answer this question, most economists usually check whether the Marshall-Lerner condition is satisfied. The Marshall-Lerner condition means that the sum of price elasticity (in absolute value) of export demand and price elasticity (in absolute value) of import demand is greater than 1, and if this condition is satisfied, an increase in the exchange rate always improves goods balance.[3)]

It requires an implicit assumption of complete the exchange rate pass-through in order to derive the Marshall-Lerner condition. The literature, however, shows that the exchange rate pass-through is not complete, and NOEM (New Open Economy Macroeconomics), introduced by Obstfeld and Rogoff (1995), makes an assumption of incomplete exchange rate pass-through.[4)] In the case of incomplete exchange rate pass-through, will an increase in the exchange rate still improve the goods balance if the Marshall-Lerner condition is satisfied? In this paper, we examine the validity of the Marshall-Lerner condition theoretically and empirically when the exchange rate pass-through is not complete.

First, we prove theoretically that an increase in the exchange rate does not always improve the goods balance when the exchange rate pass-through is not complete, even though the Marshall-Lerner condition may be satisfied. Second, we find some interesting results from estimating for nine countries; namely, Korea, Thailand, Brazil, Japan, Australia, Demark, Germany, Spain and Hungary. An increase in the exchange rate improves the goods balance for Korea, Japan, and Thailand in the short run, even where the Marshall-Lerner condition is not satisfied, and it worsens the goods balance for Germany and Hungary in the long run, even where the Marshall-Lerner condition is satisfied.[5)] Therefore, the relationship between the exchange rate and the goods balance cannot be explained only by the Marshall-Lerner condition.[6)]

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3) Rose (1991) finds that in the short run, the Marshall-Lerner condition is not satisfied in five OECD countries. Bahmani-Oskooee and Niroomand (1998) estimate long run price elasticities of export demand and import demand for 30 countries with a vector error correction model, and find that the Marshall-Lerner condition is satisfied in most countries. Suh (1999) examines the Korean case and gets the result that the Marshall-Lerner condition is not satisfied in the short run, while it is satisfied in the long run.

4) See Campa and Goldberg (2002).

5) Among OECD countries and emerging countries, we report the results of nine countries whose exchange rate pass-throughs of export and import prices as well as price elasticities of export and import demands are estimated significantly with the same equations.

6) In the literature, it is also recognized that there is a possibility that an increase in the exchange rate

This paper is organized as follows. In chapter Ⅱ, we put the assumption of incomplete exchange rate pass-through into derivation process of the Marshall-Lerner condition. We estimate short run and long run exchange rate pass-throughs of export prices and import prices as well as short run and long run price elasticities of export demand and import demand in chapter Ⅲ. Concluding remarks are represented in chapter Ⅳ.

may not improve the goods balance in the short run even when the Marshall-Lerner condition is satisfied, and that possibility is called the J-curve effect. What we, however, argue here is that an increase in the exchange rate may not improve the goods balance not only in the short run but also in the long run even when the Marshall-Lerner condition is satisfied.

II. Incomplete exchange rate pass-through and the Marshall-Lerner condition

The Marshall-Lerner condition is derived by an elasticity approach. Combining incomplete exchange rate pass-through and the elasticity approach, we are able to decompose the effects of the change in the exchange rate on goods balance into two parts as follows; the first is the effects of the price elasticities of export demand and import demand and the other is the effects of the exchange rate pass-throughs of export prices and import prices.[7)]

Exports and imports are described as a function of the consumer's local currency price. For simplicity, suppose there are only two countries, Korea and US, in the world. The goods balance is presented as in equation (1);

$$C^* = X^* - M^* = P_X^*(S)Q_X\{P_X^*(S)\} - \frac{P_M(S)}{S}Q_M\{P_M(S)\} \quad (1)$$

where * denotes value in US dollars, C, X, M, P_X, P_M, S, Q_X and Q_M represent the goods balance, exports in Korean won, imports in Korean won, export prices in Korean won, import prices in Korea won, the exchange rate of the Korean won and the US dollar, export demand (volume) and import demand (volume), respectively.

First, differentiating exports in equation (1) with respect to the exchange rate, we get equation (2);

$$\frac{\Delta \log X^*}{\Delta \log S} = N_X^E(1 + Z_X^E) \quad (2)$$

where $N_X^E = \frac{\Delta \log P_X^*}{\Delta \log S}$ and $Z_X^E = \frac{\Delta \log Q_X}{\Delta \log P_X^*}$ represent the exchange rate pass-through of export prices and price elasticity of export demand, respectively.[8)] For an increase in the exchange rate to improve the goods balance, $\frac{\Delta \log X^*}{\Delta \log S} = N_X^E(1 + Z_X^E) > 0$, export demand should be elastic, since both the exchange rate pass-through of export prices and the price elasticity of export demand have a negative sign in general.

Second, differentiating imports in equation (1) with respect to the exchange rate, we obtain equation (3);

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7) Hereafter, exports and imports indicate values in US dollar terms, not volumes.

8) For details, see Appendix 1.

$$\frac{\Delta \log M^*}{\Delta \log S} = N_M^E(1 + Z_M^E) - 1 \quad (3)$$

where $N_M^E = \frac{\Delta \log P_M}{\Delta \log S}$ and $Z_M^E = \frac{\Delta \log Q_M}{\Delta \log P_M}$ denote the exchange rate pass-through of import prices and the price elasticity of import demand, respectively.[9] In general, the exchange rate pass-through of import prices is positive, while the price elasticity of import demand is negative, which implies when the exchange rate increases, imports decrease in the case of elastic import demand, and imports increase or decrease in the case of inelastic import demand. However, since the exchange rate pass-through of import prices is usually less than unit, an increase in the exchange rate usually causes a decrease in imports.

From equations (2) and (3), we can get equation (4) which explains the effects of the change in the exchange rate on the goods balance;

$$\frac{\Delta \log X^*}{\Delta \log S} - \frac{\Delta \log M^*}{\Delta \log S} = N_X^E(Z_X^E + 1) - N_M^E(Z_M^E + 1) + 1 \quad (4)$$

This equation gives rise to several implications. First, if the exchange rate pass-throughs of export prices and import prices are complete, an increase in the exchange rate improves the goods balance when the Marshall-Lerner condition is satisfied. Since, if $N_X^E = -1$ and $N_M^E = 1$, then, $\frac{\Delta \log X^*}{\Delta \log S} - \frac{\Delta \log M^*}{\Delta \log S} = -Z_X^E - Z_M^E - 1$. If equation (5) is satisfied, an increase in the exchange rate improves the goods balance, and equation (5) simply describes the Marshall-Lerner condition itself, as the price elasticities of export demand and import demand are negative.

$$-Z_X^E - Z_M^E > 1 \quad (5)$$

Second, if $N_X^E = 0$ and $N_M^E = 0$ (zero pass-through), an increase in the exchange rate improves the goods balance regardless of whether the Marshall-Lerner condition is satisfied or not, since $\frac{\Delta \log X^*}{\Delta \log S} - \frac{\Delta \log M^*}{\Delta \log S} = 1$.

Third, if the exchange rate pass-throughs of export prices and import prices are incomplete ($-1 < N_X^E < 0, 0 < N_M^E < 1$) or are greater than unity (in absolute value), an increase in the exchange rate improves or worsens the goods balance, even

9) For details, see Appendix 1.

where the Marshall-Lerner condition is satisfied.

Therefore, in the case of incomplete exchange rate pass-through, the Marshall-Lerner condition alone can not account for the relationship between the exchange rate and the goods balance. the exchange rate pass-throughs of export prices and import prices should be taken into account in explaining that relationship.

Ⅲ. Empirical studies

1. Data

The observation period ranges from the 1st quarter of 1999 when the euro was introduced, to the 4th quarter of 2007. Except for nominal effective exchange rates, we take the data for Korea from the Bank of Korea, while we obtain the data for the other eight countries from IFS. We get nominal effective exchange rates for nine countries from the BIS. We use the unit value of exports (imports) in national currency, the index for the volume of exports (imports), nominal effective exchange rates, the unit value of world exports (imports), the index for the volume of world exports (imports), the industrial production index, the producer price index, and the oil price.[10)]

The seasonal effect is corrected using X-12 ARIMA, if necessary. For the unit root test, we employ an ADF (augmented Dickey and Fuller) test and the decision of lag length follows SC (Schwarz) criteria. We find that most variables have a unit root.[11)] In addition, we conduct a cointegration test for variables in the following equations (6), (7), (8), and (9).[12)] The test results present that they are cointegrated.

We estimate the short run and the long run exchange rate pass-throughs of export prices and import prices as well as the short run and the long run price elasticities of export demand and import demand with an ARDL (autoregressive distributed lag) model. There are two reasons we adopt the ARDL model. First, Greene (2003) explains that the ARDL model is equivalent to an error correction model when the variables are cointegrated. Second, the ARDL model is used frequently to estimate the exchange rate pass-through and the price elasticity.

As a lagged dependant variable is included as an explanatory variable in equations (6), (7), (8), (9), the variances of coefficients can be inflated by autocorrelation and heteroskedasticity. To prevent such problems, we follow the Newey and West (1987) method.

2. Exchange rate pass-through

First, we use equation (6) in order to estimate the exchange rate pass-through

10) Since there are no data on the index for the volume of world imports available, we replace them with the data on the ratio of world imports relative to the unit value of world imports.

11) For the unit root test results, see Appendix Table 1.

12) For the cointegration test results, see Appendix Table 2.

of export prices.

$$\log P_t^X = \alpha_0 + \alpha_1 \log P_{t-1}^X + \alpha_2 \log E_t + \alpha_3 \log PPI_t + \alpha_4 \log WP_t^M + u_t \quad (6)$$

where P^X, E, PPI and WP^M respectively denote the unit value of exports in national currency, the nominal effective exchange rate, the producer price index which controls marginal costs, and the unit value of world imports which controls competitor's prices. The short run and the long run exchange rate pass-throughs of export prices are $\alpha_2 - 1$ and $\frac{\alpha_2}{1-\alpha_1} - 1$, respectively.[13)]

Table 1. Estimates of the exchange rate pass-through of export prices

	Korea	Japan	Thai.	Brazil	Aust.	Den.	Ger.	Spain	Hun.
α_0	4.34 (1.75)	2.39 (0.27)	5.56 (0.75)	6.01 (0.45)	-0.59 (0.74)	1.09 (0.33)	1.20 (0.27)	1.73 (0.28)	11.36 (0.98)
α_1	0.76 (0.10)	-0.13 (0.08)	0.43 (0.09)	-0.53 (0.10)	0.28 (0.09)	0.71 (0.09)	0.59 (0.10)	0.22 (0.15)	0.06 (0.09)
α_2	0.23 (0.10)	0.50 (0.05)	0.42 (0.08)	0.47 (0.08)	0.51 (0.20)	0.09 (0.04)	-0.12 (0.10)	0.25 (0.04)	0.61 (0.05)
α_3	-0.73 (0.49)	1.48 (0.17)	0.23 (0.10)	1.23 (0.14)	1.25 (0.32)	0.06 (0.09)	0.08 (0.12)	0.58 (0.15)	0.43 (0.07)
α_4	0.25 (0.22)	-0.37 (0.04)	0.01 (0.08)	-0.54 (0.20)	0.10 (0.25)	0.08 (0.06)	-0.06 (0.27)	0.07 (0.03)	-0.19 (0.04)
$\frac{\alpha_2}{1-\alpha_1}$	0.93 (0.48)	0.44 (0.03)	0.73 (0.15)	0.31 (0.07)	0.71 (0.29)	0.32 (0.15)	-0.30 (0.07)	0.32 (0.03)	0.65 (0.05)
SR	-0.77	-0.50	-0.58	-0.53	-0.49	-0.91	-1.12	-0.75	-0.39
LR	-0.07	-0.56	-0.27	-0.69	-0.29	-0.68	-1.30	-0.68	-0.35
R^2	0.90	0.93	0.94	0.95	0.97	0.86	0.85	0.96	0.95

Note: ( ) represents the standard error.

The results are presented in Table 1. Compared to other countries, Korea has the lowest (absolute value) long run exchange rate pass-through of export prices. Presumably, this is because Korea currency depreciated during the observation period and exporters did not pass through the depreciation of the Korean currency to export prices, for fear losing market share.

13) The standard error of $\frac{\alpha_2}{1-\alpha_1}$ is calculated as below;

$$s.e = \sqrt{(\frac{1}{(1-\alpha_1)})^2 Variance[\alpha_2] + (\frac{\alpha_2}{(1-\alpha_1)^2})^2 Variance[\alpha_1] + 2(\frac{1}{(1-\alpha_1)})(\frac{\alpha_2}{(1-\alpha_1)^2}) Covariance[\alpha_1, \alpha_2]}$$

Next, we use equation (7) to estimate the exchange rate pass-through of import prices. On the right hand side of equation (7), we use the unit value of world exports as a proxy for competitor's prices and employ, as in Chiang (2003), the industrial production index as a proxy for demand pressure in the destination country and the oil price for a world supply shock.[14)]

$$\log P_t^M = \beta_0 + \beta_1 \log P_{t-1}^M + \beta_2 \log E_t + \beta_3 \log WP_t^X + \beta_4 \log IP_t + \beta_5 \log OIL_t + u_t \qquad (7)$$

where P^M, WP^X, IP and OIL respectively represent the unit value of imports in the national currency, the unit value of world export, the industrial production index and the oil price. Therefore, the short run exchange rate pass-through of import prices is β_2 and its long run exchange rate pass-through is $\frac{\beta_2}{1-\beta_1}$.

Table 2. Estimates of the exchange rate pass-through of import prices

	Korea	Japan	Thai.	Brazil	Aust.	Den.	Ger.	Spain	Hun.
β_0	6.20 (0.66)	2.14 (0.69)	8.02 (0.86)	0.36 (3.64)	7.77 (0.83	2.81 (0.39)	1.67 (0.48)	2.56 (0.44)	6.22 (0.35)
β_1	0.36 (0.05)	0.56 (0.06)	0.33 (0.11)	0.07 (0.04)	0.28 (0.10)	0.48 (0.06)	0.50 (0.11)	0.37 (0.05)	-0.02 (0.06)
β_2	0.61 (0.08)	0.41 (0.07)	0.54 (0.07)	0.43 (0.18)	0.68 (0.11)	0.12 (0.03)	0.44 (0.06)	0.19 (0.05)	0.75 (0.07)
β_3	-0.13 (0.08)	-0.25 (0.09)	-0.57 (0.13)	-0.44 (0.36)	-0.11 (0.09)	-0.04 (0.04)	0.13 (0.06)	-0.10 (0.06)	-0.34 (0.06)
β_4	-0.25 (0.06)	0.54 (0.14)	0.30 (0.13)	1.49 (0.87)	-0.29 (0.10)	0.01 (0.02)	0.44 (0.20)	0.27 (0.15)	0.38 (0.06)
β_5	0.28 (0.05)	0.10 (0.04)	0.12 (0.02)	0.24 (0.14)	0.10 (0.02)	0.06 (0.01)	0.01 (0.02)	0.10 (0.01)	0.04 (0.02)
$\frac{\beta_2}{1-\beta_1}$	0.95 (0.14)	0.92 (0.16)	0.81 (0.13)	0.46 (0.20)	0.94 (0.07)	0.23 (0.05)	0.88 (0.13)	0.29 (0.07)	0.73 (0.07)
SR	0.61	0.41	0.54	0.43	0.68	0.12	0.44	0.19	0.75
LR	0.95	0.92	0.81	0.46	0.94	0.23	0.88	0.29	0.73
R^2	0.89	0.98	0.98	0.67	0.97	0.96	0.95	0.95	0.92

Note: ( ) represents the standard error.

The results are summarized in Table 2. The short run exchange rate pass-throughs of import prices are relatively low in the euro area. This might be because the euro is used as an invoice currency. Except for Denmark, Spain and

14) GDP might be more desirable than the industrial production index. when replacing GDP by the industrial production index, the estimated coefficients are statistically insignificant in most countries. So we stick to the industrial production index except for Thailand where it is not available.

Brazil, the long run exchange rate pass-throughs of import prices are complete.

3. Price elasticity

We estimate the price elasticities of export demand and import demand, using equations (8) and (9).[15] In equation (8), explanatory variables are composed of export prices, competitor's prices, domestic demand pressure, world import demand, and a lagged dependent variable.[16]

$$\log Q_t^X = \gamma_0 + \gamma_1 \log Q_{t-1}^X + \gamma_2 \log P_t^{X*} + \gamma_3 \log WP_t^X + \gamma_4 \log DD_t + \gamma_5 \log WQ_t^M + u_t \qquad (8)$$

where Q^X, P^{X*}, WP^X, DD and WQ^M respectively denote the index for the volume of exports, the unit value of exports in dollars, the unit value of world exports, the ratio of domestic demand to exports, and the index for the volume of world imports.[17] The short run price elasticity of export demand is γ_2 and its long run price elasticity is $\frac{\gamma_2}{1-\gamma_1}$.

Table 3. Estimates of price elasticity of export demand

	Korea	Japan	Thai.	Brazil	Aust.	Den.	Ger.	Spain	Hun.
γ_0	-0.56 (0.70)	0.77 (0.27)	-0.14 (0.24)	-2.04 (0.47)	0.06 (0.71)	0.50 (0.14)	1.76 (0.27)	-0.42 (0.57)	-1.09 (0.32)
γ_1	0.44 (0.18)	0.84 (0.12)	0.25 (0.18)	-0.03 (0.08)	0.61 (0.06)	0.58 (0.08)	0.20 (0.10)	0.60 (0.11)	0.62 (0.09)
γ_2	-0.49 (0.14)	-0.18 (0.08)	-0.56 (0.16)	-0.79 (0.15)	-0.78 (0.23)	-0.28 (0.06)	0.15 (0.10)	0.28 (0.12)	0.47 (0.12)
γ_4	-0.72 (0.28)	-	-0.32 (0.06)	-0.13 (0.05)	-3.07 (0.42)	-	-2.10 (0.27)	-0.30 (0.13)	-0.74 (0.14)
γ_5	0.62 (0.31)	0.00 (0.09)	0.80 (0.22)	1.55 (0.09)	0.30 (0.16)	0.31 (0.06)	0.28 (0.12)	0.24 (0.11)	0.54 (0.16)
$\frac{\gamma_2}{1-\gamma_1}$	-0.87 (0.26)	-1.12 (0.91)	-0.75 (0.26)	-0.76 (0.17)	-2.02 (0.47)	-0.67 (0.18)	0.19 (0.12)	0.69 (0.37)	1.24 (0.39)
SR	-0.49	-0.18	-0.56	-0.79	-0.78	-0.28	0.15	0.28	0.47
LR	-0.87	-1.12	-0.75	-0.76	-2.02	-0.67	0.19	0.69	1.24
R^2	0.99	0.96	0.99	0.97	0.96	0.96	0.88	0.97	1.00

Note: ( ) represents the standard error.

15) The equations are similar to Lee and Han (2001), Senhadji and Montenenegro (1998), and Yun (2007).

16) The domestic demand ratio is not statistically significant in Japan and Demark, and we estimate equation (8) without that variable for these two countries.

17) When estimating this equation, we use the relative price of exports against world export prices. This is why only estimates of γ_2 are reported in Table 3.

Table 3 summarizes the results. The short run and the long run price elasticities of export demand differ across countries. Australia and Brazil show relatively high elasticities. In the cases of Japan and Korea, the price elasticities of export demand are relatively low in the short run but relatively high in the long run. Germany, Hungary, and Spain have positive elasticities contrary to the prediction of the theory.

Finally, we estimate the price elasticity of import demand using equation (9) whose explanatory variables include import prices, competitor's prices of imports, and domestic production.

$$\log Q_t^M = \delta_0 + \delta_1 \log Q_{t-1}^M + \delta_2 \log P_t^M + \delta_3 \log PPI_t + \delta_4 \log IP_t + u_t \quad (9)$$

where Q^M, P^M, PPI and IP represent the index for the volume of imports, the unit value of imports in the destination currency, the producer price index, and the industrial production index, respectively. The short run price elasticity of import demand is δ_2 while its long run price elasticity is $\frac{\delta_2}{1-\delta_1}$.

Table 4 provides a summary of the results. As predicted by the theory, the price elasticities of import demand show a negative sign for all countries in the short run as well as in the long run. Korea's long run price elasticity is the lowest among the countries surveyed.

Table 4. Estimates of the price elasticity of import demand

	Korea	Japan	Thai.	Brazil	Aust.	Den.	Ger.	Spain	Hun.
δ_0	-0.22 (0.08)	-0.45 (0.39)	1.41 (0.97)	3.70 (0.89)	3.89 (1.02)	-1.48 (0.65)	-0.45 (0.60)	-1.37 (0.77)	-1.38 (0.26)
δ_1	0.24 (0.09)	0.84 (0.12)	0.25 (0.18)	-0.03 (0.08)	0.61 (0.06)	0.58 (0.08)	0.20 (0.10)	0.60 (0.11)	0.62 (0.09)
δ_2	-0.31 (0.08)	-0.07 (0.04)	-0.29 (0.13)	-0.65 (0.07)	-1.77 (0.21)	-0.32 (0.18)	-0.39 (0.15)	-0.53 (0.11)	-0.32 (0.17)
δ_4	0.86 (0.11)	0.16 (0.08)	0.05 (0.14)	0.22 (0.21)	-0.24 (0.24)	0.61 (0.22)	0.47 (0.28)	0.62 (0.25)	0.94 (0.14)
$\frac{\delta_2}{1-\delta_1}$	-0.41 (0.10)	-1.24 (1.12)	-1.99 (1.90)	-0.64 (0.07)	-2.94 (0.15)	-1.10 (0.27)	-1.04 (0.16)	-2.14 (0.43)	-1.38 (0.26)
SR	-0.31	-0.07	-0.29	-0.65	-1.77	-0.32	-0.39	-0.53	-0.32
LR	-0.41	-1.24	-1.99	-0.64	-2.94	-1.10	-1.04	-2.14	-1.38
R^2	0.99	0.96	0.98	0.81	0.99	0.98	0.98	0.98	0.99

Note: ( ) represents the standard error.

4. Effects of a change in the exchange rate on the goods balance

A. Goods balance

Using the results for the exchange rate pass-throughs of export prices and import prices as well as the price elasticities of export demand and import demand, we can measure the effects of the change in the exchange rate on exports, imports, and the goods balance. Table 5. summarizes these results.

Table 5. Effects of a change in the exchange rate on the goods balance

	Korea	Japan	Thai.	Brazil	Aust.	Den.	Ger.	Spain	Hun.
exchange rate pass-through of export prices									
SR	-0.77	-0.50	-0.58	-0.53	-0.49	-0.91	-1.12	-0.75	-0.39
LR	-0.07	-0.56	-0.27	-0.69	-0.29	-0.68	-1.30	-0.68	-0.35
price elasticity of export demand									
SR	-0.49	-0.18	-0.56	-0.79	-0.78	-0.28	0.15	0.28	0.47
LR	-0.87	-1.12	-0.75	-0.76	-2.02	-0.67	0.19	0.69	1.24
effects of the change in the exchange rate on exports									
SR	-0.40	-0.41	-0.26	-0.11	-0.11	-0.65	-1.29	-0.96	-0.57
LR	-0.01	0.07	-0.07	-0.16	0.30	-0.23	-1.54	-1.15	-0.78
exchange rate pass-through of import prices									
SR	0.61	0.41	0.54	0.43	0.63	0.12	0.44	0.19	0.75
LR	0.95	0.92	0.81	0.46	0.94	0.23	0.88	0.29	0.73
price elasticity of import demand									
SR	-0.31	-0.07	-0.29	-0.65	-1.77	-0.32	-0.39	-0.53	-0.32
LR	-0.41	-1.24	-1.99	-0.64	-2.94	-1.10	-1.04	-2.14	-0.43
effects of a change in the exchange rate on imports									
SR	-0.58	-0.62	-0.61	-0.85	-1.52	-0.92	-0.73	-0.91	-0.49
LR	-0.44	-1.22	-1.81	-0.84	-2.83	-1.02	-1.04	-1.33	-0.58
Marshall-Lerner condition									
SR	0.94	0.26	0.85	1.44	2.55	0.60	0.54	0.80	0.79
LR	1.29	2.37	2.74	1.40	4.97	1.77	1.23	2.83	1.67
effects of a change in the exchange rate on the goods balance									
SR	0.18	0.21	0.36	0.74	1.41	0.27	-0.56	-0.05	-0.08
LR	0.43	1.29	1.74	0.67	3.13	0.80	-0.51	0.19	-0.20

First, in the short run, an increase in the exchange rate decreases exports in most countries, while in the long run, it increases exports in Australia, and decreases them in Brazil, Denmark, Germany, Spain, and Hungary.

Second, in the short run as well as in the long run, an increase in the exchange rate decreases imports in all countries. In addition, except for Korea and Brazil, import decreases more in the long run than in the short run.

Third, even though the Marshall-Lerner condition is satisfied only in Australia and Brazil in the short run, an increase in the exchange rate improves the goods balance in all countries except for Germany and Hungary. In addition, even though the Marshall-Lerner condition is satisfied in all countries in the long run, an increase in the exchange rate worsens the goods balance in Germany and Hungary. In the case of Brazil, both of the short run and the long run effects of the change in the exchange rate on the goods balance are almost identical, while Korea and other countries experience a greater improvement in the long run, which is explained by the J-curve effect.

Fourth, when the exchange rate increases, Korea experiences the least improvement in the goods balance in the long run due to the low price elasticity of import demand.

B. Volumes of exports and imports

The above results also provide useful information on the effects of the change in the exchange rate on the volumes of exports and imports. First, we modify equation (2) and derive equation (10).[18)]

$$\frac{\Delta \log X^*}{\Delta \log S} = N_X^E(1 + Z_X^E) \tag{2}$$

$$\frac{\Delta \log Q_X}{\Delta \log S} = N_X^E Z_X^E \tag{10}$$

The effects of the change in the exchange rate on the volume of exports are equal to the exchange rate pass-through of export prices multiplied by the price elasticity of export demand. As the exchange rate pass-through of export prices and the price elasticity of export demand have a negative sign in general, the volume of export rises when the exchange rate increases.

Second, we also modify equation (3) and derive equation (11).[19)]

18) For details, see Appendix 2.

19) For details, see Appendix 2.

$$\frac{\Delta \log M^*}{\Delta \log S} = N_M^E(1 + Z_M^E) - 1 \quad (3)$$

$$\frac{\Delta \log Q_M}{\Delta \log S} = N_M^E Z_M^E \quad (11)$$

The effects of a change in the exchange rate on the volume of imports are equal to the multiple of the exchange rate pass-through of import prices and the price elasticity of import demand. As the exchange rate pass-through of import prices has a positive sign and the price elasticity of import demand has a negative sign in general, an increase in the exchange rate decreases volume of imports.

We summarize the effects of a change in the exchange rate on the volumes of exports and imports in Table 6. First, except for Germany, Hungary, and Spain whose the price elasticities of export demand show a positive sign, an increase in the exchange rate increases the volume of exports in the short run as well as in the long run. Among our sample countries, the effects of a change in the exchange rate on the volume of exports are the smallest in Korea.[20] This is because Korea's long run exchange rate pass-through of export prices is relatively low.

Second, in all countries, an increase in the exchange rate decreases the volume of imports in the short run as well as in the long run, and the short run effects are greater than the long run ones. In the case of Korea, an increase in the exchange rate decreases the volume of import very little due to low price elasticity of import demand.

Table 6. Effects of a change in the exchange rate on the volume of exports and imports

	Korea	Japan	Thai.	Brazil	Aust.	Den.	Ger.	Spain	Hun.
volume of export									
SR	0.38	0.09	0.33	0.42	0.38	0.26	-0.17	-0.21	-0.18
LR	0.06	0.63	0.20	0.53	0.59	0.46	-0.24	-0.47	-0.43
volume of import									
SR	-0.19	-0.03	-0.16	-0.28	-1.20	-0.04	-0.17	-0.10	-0.24
LR	-0.39	-1.14	-1.62	-0.30	-2.77	-0.25	-0.91	-0.63	-0.31

20) Yoon (2004) studies the impact of the nominal effective exchange rate on export demand over the first quarter of 1993 to the first quarter of 2004. Export demand rises by 0.2% in the long run when the exchange rate increases by 10%. This result is not substantially different from ours.

IV. Conclusions

It is well known that if the Marshall-Lerner condition is satisfied, an increase in the exchange rate always improves the goods balance. That condition, however, is derived on the assumption that the exchange rate pass-through is complete. The literature shows that the exchange rate pass-through is not complete, and it is necessary to test for the validity of the Marshall-Lerner condition in the case of incomplete exchange rate pass-through.

First, we prove theoretically that the Marshall-Lerner condition is valid only when the exchange rate pass-throughs of export prices and import prices are complete. In the case of zero pass-through, an increase in the exchange rate always improves the goods balance regardless of whether the Marshall-Lerner condition is satisfied or not. When the exchange rate pass-throughs of export prices and import prices are neither complete nor zero, an increase in the exchange rate improves or worsens the goods balance even though the Marshall-Lerner condition is satisfied.

Second, we show empirically that an increase in the exchange rate increases or decreases the goods balance even though the Marshall-Lerner condition is satisfied. In the long run, the Marshall-Lerner condition is satisfied in all nine countries, but an increase in the exchange rate worsens the goods balance in Germany and Hungary. In the short run, the Marshall-Lerner condition is not satisfied in Korea, Japan, Thailand, and Denmark; nevertheless an increase in the exchange rate, however, improves the goods balance in these countries.

Both theoretical and empirical studies demonstrate that the relationship between the exchange rate and the goods balance depends on not only on the price elasticities of export demand and import demand but also on the exchange rate pass-throughs of export prices and import prices. Therefore, in the case of incomplete the exchange rate pass-through, the Marshall-Lerner condition is no longer valid.

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<Appendix 1>

Differentiating exports with respect to the exchange rate, equation (2) is derived as follows;

$$\frac{\Delta X^*}{\Delta S} = \frac{\Delta P_X^*}{\Delta S} Q_X + P_X^* \frac{\Delta Q_X}{\Delta P_X^*} \frac{\Delta P_X^*}{\Delta S} = \frac{\Delta P_X^*}{\Delta S} \frac{S}{P_X^*} \frac{X^*}{S} + P_X^* \frac{\Delta Q_X}{\Delta P_X^*} \frac{\Delta P_X^*}{\Delta S}$$

$$= N_X^E \frac{X^*}{S} + P^* \frac{\Delta Q_X}{\Delta P_X^*} \frac{\Delta P_X^*}{\Delta S} \qquad (N_X^E = \frac{\Delta \log P_X^*}{\Delta \log S})$$

$$= N_X^E \frac{X^*}{S} + \frac{\Delta Q_X}{\Delta P_X^*} \frac{P_X^*}{Q_X} \frac{\Delta P_X^*}{\Delta S} \frac{S}{P_X^*} \frac{X^*}{S} \qquad (P_X^* = \frac{X^*}{Q_X})$$

$$= N_X^E \frac{X^*}{S} + Z_X^E N_X^E \frac{X^*}{S} \qquad (Z_X^E = \frac{\Delta \log Q_X}{\Delta \log P_X^*})$$

$$\frac{\Delta X^*}{\Delta S} \frac{S}{X^*} = \frac{\Delta \log X^*}{\Delta \log S} = N_X^E (1 + Z_X^E) \tag{2}$$

Differentiating equation (A3) with respect to the exchange rate, equation (3) is derived as follows;

$$\frac{\Delta M^*}{\Delta S} = \frac{\frac{\Delta P_M}{\Delta S} S - P_M}{S^2} Q_M + \frac{P_M}{S} \frac{\Delta Q_M}{\Delta P_M} \frac{\Delta P_M}{\Delta S}$$

$$= \frac{Q_M}{S} \frac{\Delta P_M}{\Delta S} - \frac{P_M}{S^2} Q_M + \frac{\Delta Q_M}{\Delta P_M} \frac{P_M}{Q_M} \frac{\Delta P_M}{\Delta S} \frac{S}{P_M} \frac{M^*}{S} \qquad (\frac{P_M}{S} = \frac{M^*}{Q_M})$$

$$= \frac{\Delta P_M}{\Delta S} \frac{S}{P_M} \frac{M^*}{S} - \frac{M^*}{S} + \frac{\Delta Q_M}{\Delta P_M} \frac{P_M}{Q_M} \frac{\Delta P_M}{\Delta S} \frac{S}{P_M} \frac{M^*}{S} \qquad (Q_M = \frac{M^*}{P_M/S})$$

$$= N_M^E \frac{M^*}{S} - \frac{M^*}{S} + Z_M^E N_M^E \frac{M^*}{S} \quad (N_M^E = \frac{\Delta \log P_M}{\Delta \log S}, Z_M^E = \frac{\Delta \log Q_M}{\Delta \log P_M})$$

$$\frac{\Delta M^*}{\Delta S} \frac{S}{M^*} = \frac{\Delta \log M^*}{\Delta \log S} = N_M^E (1 + Z_M^E) - 1 \tag{3}$$

<Appendix 2>

$$\frac{\triangle \log X^*}{\triangle \log S} = \frac{\triangle \log P_X^* Q_X}{\triangle \log S} = \frac{\triangle \log P_X^*}{\triangle \log S} + \frac{\triangle \log Q_X}{\triangle \log S} = N_X^E(1+Z_X^E)$$

$$(\Delta \log X^* = \Delta \log P_X^* Q_X\,,\ \frac{\Delta \log P_X^*}{\Delta \log S} = N_X^E)$$

$$\frac{\triangle \log Q_X}{\triangle \log S} = N_X^E(1+Z_X^E) - N_X^E = N_X^E Z_X^E \tag{10}$$

$$\frac{\triangle \log M^*}{\triangle \log S} = \frac{\triangle \log \frac{P_M}{S} Q_M}{\triangle \log S} = \frac{\triangle \log \frac{P_M}{S}}{\triangle \log S} + \frac{\triangle \log Q_M}{\triangle \log S} = N_M^E(1+Z_M^E) - 1$$

$$(\Delta \log M^* = \Delta \log \frac{P_M}{S} Q_X\,)$$

$$\frac{\triangle \log Q_M}{\triangle \log S} = N_M^E(1+Z_M^E) - 1 - \frac{\triangle \log P_M - \Delta \log S}{\triangle \log S} \qquad (\frac{\Delta \log P_M}{\Delta \log S} = N_M^E)$$

$$\frac{\triangle \log Q_M}{\triangle \log S} = N_M^E Z_M^E \tag{11}$$

<Appendix Table 1> Results of unit root test

	Korea	Japan	Thai.	Brazil	Aust.	Den.	Ger.	Spain	Hun.
					Prob,*(lag)				
1	0.33(4)	0.45(0)	0.17(1)	0.00(0)	0.60(0)	0.94(0)	0.94(0)	0.93(0)	0.31(1)
2	0.71(1)	0.24(3)	0.99(0)	0.99(1)	0.98(3)	0.99(0)	0.98(0)	0.99(0)	0.99(0)
3	0.29(0)	0.51(0)	0.48(0)	0.21(1)	0.98(3)	0.26(0)	0.66(0)	1.00(0)	0.06(0)
4	0.47(0)	0.91(0)	0.09(1)	0.16(0)	0.50(0)	0.17(0)	0.57(1)	1.00(3)	0.04(0)
5	0.99(0)	0.99(4)	0.99(0)	0.99(5)	0.35(2)	0.99(3)	0.96(0)	0.58(0)	0.99(1)
6	0.99(0)	0.85(0)	0.88(0)	0.00(0)	0.99(2)	1.00(3)	0.91(1)	0.00(0)	0.99(3)
7	0.46(1)	0.61(3)	0.05(0)	0.00(0)	0.41(0)	0.02(0)	2.44(0)	1.00(0)	0.00(0)
8	0.99(1)	0.52(1)	0.99(0)	0.97(0)	0.83(0)	0.95(3)	0.98(1)	0.84(0)	0.99(3)
9	0.95(0)	0.76(1)	0.99(0)	0.78(2)	0.98(0)	1.00(0)	0.98(1)	0.99(0)	0.83(0)
10					0.96(1)				
11					0.97(3)				
12					0.99(2)				
13					0.99(4)				
14					0.99(0)				

MacKinnon (1996) one-sided p-values

Notes: 1. nominal effective exchange rate
2. unit value of exports in US dollar
3. unit value of exports in domestic currency
4. unit value of imports in domestic currency
5. index for volume of exports
6. index for volume of imports
7. domestic demand ratio
8. industrial production index
9. producer price index
10. unit value of world exports
11. unit value of world imports
12. index for volume of world exports
13. index for volume of world imports
14. oil price

<Appendix Table 2> Results of cointegration test[21)]

	Korea	Japan	Thai.	Brazil	Aust.	Den.	Ger.	Spain	Hun.
				1997:1Q ~ 2007:4Q					
1	-0.54	-6.75	-5.94	-5.93	-6.61	-5.07	-6.54	-6.71	-3.62
2	-7.06	-5.59	-6.35	-5.57	-6.69	-6.14	-6.85	-6.77	-6.56
3	-6.04	-5.35	-4.96	-4.95	-5.86	-5.99	-5.22	-5.94	-3.11
4	-5.88)	-5.92	-5.57	-4.55	-5.59	-6.04)	-4.83	-5.68	-5.00

Note: 1. export prices equation
2. export demand equation
3. import prices equation
4. import demand equation

21) These are the results of unit root tests for the residuals of all equations.