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Pass-Through of Exchange Rates on Import Prices in East Asian Countries

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1. Introduction

In 1997 countries in East Asia suffered currency crises. Despite their strong trade relations with Japan, these countries had adopted a currency basket peg system weighted heavily in favor of the U.S. dollar. This might make their import and export prices vulnerable to the exchange rate risk of the Japanese yen.

Recently, exchange pass-through studies have received renewed attention. In the late 1980s, pass-through studies focused on industrial organization and the price discriminations between domestic market and foreign market. Those studies use partial equilibrium models, and much empirical evidence has been gathered from developed countries. Recent studies are based on the new open macroeconomic models of Obsfeld and Rogoff (1995). These papers use sticky price models to consider the differences between the effect when producers set prices in the consumers' currency and the effect when exporters set prices in the producers' currency.

Although the new wave of pass-through studies includes models of various types, most such models that examine the selection of an exchange regime suggest that "the type of price stickiness may be of critical importance," (Devereux and Engel (1998)). This indicates that empirical analysis of import prices has become more important in understanding what kind of price stickiness is found in East Asian countries. For example, if the pass-through of exchange rates on import prices in East Asian countries is low, then the fluctuations of exchange rates will have little effect on import prices in the case that these countries adopt floating exchange rates.

This paper examines the pass-through of exchange rates on import prices in East Asian countries. We use aggregated data and 9-digit industry import unit values provided by Japan Tariff Association.

Empirical analysis using aggregated data found that changes in the U.S. dollar affected the import prices of Asian countries except Singapore but the yen had no such effects. The empirical analysis using 9-digit industry import unit values found that the import prices of 3 goods out of 11 were affected by yen rates.

Section 2 surveys recent literature on pass-through. Section 3 provides a simple analysis of aggregated data. Section 4 explains a model of pass-through and an empirical framework. Section 5 shows the regression results. Section 6 summarizes the conclusions.

2. Recent Literature on Pass-Through of Exchange Rates

Recent studies on pass-through combine past pass-through studies, empirical evidences of purchasing power parity (PPP), and a sticky price model of new open macroeconomics. This section briefly reviews this literature.

After the Plaza Accord of 1985, the yen appreciated dramatically against the U.S. dollar, but the current account balances of the U.S. and Japan did not change as expected. The reasons for this have been researched, and many studies (e.g., Marston (1990), Knetter (1993)) have presented considerable empirical evidences that the PTM behavior of Japanese exporters can be observed.

The PPP hypothesis had been studied for many years; however, Engel (1993) and Engel and Rogers (1994) showed that violation of the law of one price across national borders is much greater than can be explained by geographical distance or transportation costs. Their analysis, using a co-integration technique with longer time-series data, also shows that the law of one price is violated beyond mere short-term adjustments. Feenstra and Kendall (1997) found that a significant portion of observed deviations in the law of one price are attributable to incomplete exchange rate pass-through that results from PTM behavior. That is, PTM, or local currency price-setting behavior, is recognized as one reason for violation of the law of one price.

In new-open macroeconomics, Obstfeld and Rogoff (1995) have developed a sticky price model. They assume that the price is set in the producers' currency and that there is no violation of the law of one price. Betts and Devereux (1996) extended the model of Obstfeld and Rogoff (1995) to allow for PTM. Betts and Devereux (1996) developed a general equilibrium model consistent with the non-response of prices to exchange rate movements that are generated by money shocks. They showed that the combination of PTM and sticky local-currency nominal prices amplifies the effect of money shocks on exchange rates.

In the new wave of pass-through studies, Devereux and Engel (1998) directly examined how price setting affects the optimal choice of exchange rate regime. They show that when prices are set in consumers' currency, adopting floating exchange rate system would become better because floating exchange rate insulates domestic consumption from foreign monetary shocks. Under floating exchange rates, the prices paid by home residents for imported goods are not affected by exchange rate fluctuations if producers set the price in the consumers' currency. When prices are set in the producers' currency, fixed exchange regime is better than floating exchange rate

system if the negative effect of uncertainty of floating exchange rates on domestic consumption dominates the insulation effect of float exchange regime. This reveals that when prices are set in the producers' currency, there is a tradeoff between floating and fixed exchange rates. Exchange rate adjustment under floating rates allows for a lower variance of consumption, but exchange rate volatility itself leads to a lower average level of consumption.

Campa and Goldberg (2004) provide empirical evidences on the exchange rate pass through into the import prices of twenty three OECD countries. Using quarterly data from 1975 through 2003, they estimate pass-through elasticities. They find that countries with less exchange rate and inflation variability are likely to have lower rates of pass-through of exchange rates into import prices. They also find that there has been a weak tendency toward declines in exchange rate pass-through rates. The empirical analysis in this paper are similar to Campa and Goldberg (2004) but we focus on the Asian countries.

3. Aggregated Data

This section uses aggregated data to consider the macro effects of pass-through. To investigate the effects of exchange rates on aggregated import prices, the following equation is estimated separately by country.

$$(1) \quad \Delta(P^m_t) = \alpha + \beta \Delta S^{\$}_t + \gamma \Delta S^{Y}_t + u_t,$$

Where $S^{\$}_t$ is nominal U.S. dollar rate (per one U.S. dollar) at time t, S^{Y}_t is nominal Japanese yen rate (per one yen) at time t, P^m is price of import goods in the currency of the importing country, heading Δ denotes the variable is the rate of change. β is pass-through elasticity of U.S. dollar rates on import prices. γ is pass-through elasticity of yen rates on import prices. If these pass-through elasticities are high, exporters might set prices in their currency (non PTM). If the coefficients are near zero, pass-through is incomplete and exporters might set prices in the consumer's currency.

The data are annual and the period is 1974 to 2000. Philippine data are only up to 1990. The data are from the IFS CD-ROM and Taiwan's National Statistics Home Page (http://www.stat.gov.tw/).

Table 1 shows the results of the equation for the effects of exchange rates on aggregated import prices. The coefficient of U.S. dollar (β) is positive and significant in Korea, Philippines, Thailand, Taiwan, Hong Kong and Japan. The exception is only Singapore. This may mean that U.S. exporters will set the prices of goods to those countries except Singapore in U.S. dollars. The coefficients of Japanese yen (γ) are not positive. This may mean that Japanese exporters will set the prices in the consumers' currency in the East Asian countries.

If we use changes of effective exchange rates as an independent variable, the coefficient of changes of effective exchange rates becomes one when pass-through is complete. However, as we couldn't get effective rates of some Asian countries, we put U.S. dollar rate and Japanese Yen rate separately. Thus, when pass-through is complete, the coefficient of U.S. dollar rate becomes the

Table 1 Pass-through coefficients (Aggregated data)

Coefficient	C	t stat.	US$	t stat.	JPY	t stat.	R bar Square	F Stat (US$)	Signif. Level	F stat. (JPY)	Signif. Level
Korea	0.1	2.2	0.8	3.4	−0.2	−1.1	0.28	0.75	0.40	32.75	0
Phillipines	0.1	2.1	1.3	3.1	−0.6	−1.9	0.30	0.47	0.50	28.21	0
Singapore	0	0.9	0	−0.1	−0.1	−0.9	−0.05	14.84	0	95.85	0
Thailand	0.1	4.1	0.6	2.3	−0.4	−2.1	0.19	2.13	0.16	51.51	0
Taiwan	0	1.0	1.4	5.7	−0.1	−0.9	0.57	2.19	0.15	59.74	0
Hong Kong	0	2.5	0.5	1.8	0	0.1	0.07	3.61	0.07	81.32	0
Japan	0	1.9	1.2	5.4	0	0	0.52	0.80	0.38	−	−
Germany	0	2.3	0.4	3.1	−0.3	−1.9	0.25	16.34	0	69.14	0
US	0.1	2.7	0	0	−0.1	−0.8	−0.01	−	−	48.23	0

import share of U.S. and the coefficient of Japanese Yen rate becomes the import share of Japan. We report F value with the restriction that the coefficient of U.S. dollar rate is the import share of U.S. and the coefficient of Japanese Yen rate is the import share of Japan.

F statics are all significant for the coefficients of Yen and are not significant for the coefficients of U.S. dollar. This means that Yen rates don't pass through into the import price of Asian countries and U.S. dollar rates pass through into import price of Asian countries.

4. Model of PTM and Empirical Framework

Many papers have analyzed pass-through of exchange rates empirically. Knetter (1989) published a highly regarded study on pass-through of exchange rates. This section reviews Knetter's model, in order to explain the empirical framework of the analysis in Section Three.

Consider an exporter selling to N foreign destinations, indexed by i. Demand in each destination market is assumed to have the general form of

$$(2)\quad q_{it} = f_i(s_{it} p_{it})\, v_{it}$$
$$i = 1, \ldots, N,\ t = 1, \ldots, T$$

where q_{it} is quantity demanded by destination market i in period t, p is price in terms of the exporter's currency, s is the exchange rate (destination market currency per unit of the export er's currency), and v is a random variable that may cause demand to shift. The exporter's profit in period t is,

$$(3)\quad \Pi_t = \Sigma p_{it} q_{it} - C(\Sigma q_{it})\, z_t.$$

Where C is cost function and z_t is a random variable that may shift the cost function in period t. The first-order condition is,

$$(4)\quad p_{it} = c_t(e_{it}/(e_{it-1})),$$
$$i = 1, \ldots, N,\ t = 1, \ldots, T,$$

Where c_t is the marginal cost of production in period t and e_{it} is the elasticity of demand with respect to local currency price in destination market i. This price equation is the basic case in an incomplete market. The marginal cost, c, is common among destination countries. The markups over marginal cost differ among destination countries and this is the source of price discrimination. If the market is competitive, the markup over marginal cost is infinite and the marginal cost is equated to the world price.

The estimated equation is the following.

$$(5)\quad \Delta S_{it} P_{it} = \text{Country}_i + \text{year}_t + \beta_i \Delta S_{it} + u_{it},$$

Where S is nominal exchange rate of Yen (unit of country i's currency per yen) at time t, P is price of export goods (from Japan) in yen, year is a dummy variable that takes the value of 1 at time t and the value of 0 for the other time, and Country is a country dummy variable.

In the literature on pass-through, it is usual to use the price in terms of yen as the left-hand side variable of the equation. However, our interest here is how the exchange rates affect the price in terms of destination market (import side) currency, so I use S_{it}, P_{it} as the dependent variable instead of P_{it}.

β is pass-through elasticity. If producers set the prices in their own currencies, then import prices will be affected by the exchange rate and β will become positive. If producers set the prices in consumers' currency, import prices will not be affected by the exchange rate and β will become zero.

5. Results of Empirical Analysis

5.1. Description of Data

The data of Japanese import goods (9-digit) were collected from the JTrade, a Web-based search service that provides statistics on Japan's foreign trade from Japan Exports and Imports. The data of JTrade start from 1988. Before 1988, the data were classified by a different system (7-digit) but those data are roughly corresponding to data (9-digit) after 1988. We collected corresponding data (7-digit) from Japan Exports and Imports (1973–1987).

We chose 11 industries, following Knetter (1989). The data are annual, and the period is from 1976 to 2000. Exchange rate data were collected from IFS CD-ROM. The exchange rate series was adjusted using 1990 as the base year.

5.2. Regression Results

Table 2 shows the results. The first column is the estimated coefficient of intercept (α). The reported coefficients (excluding that for the U.S.) are the differentials from the coefficient of U.S. variable. The second column is the estimated coefficient of yen rates (β). Like the first column, the reported coefficients (excluding that of the U.S.) are the differentials from the coefficient of U.S. variable. The third column is the sum of β for U.S. and β for each other country. Thus the coefficients in the third column are not differential and show each country's pass-through

Table 2　Pass-through coefficients (9-digit industry data)

Selenium (2804220)

	Alpha		Beta		(US+Country dummy)	
	Coef.	(t stat.)	Coef.	(t stat.)	Coef.	(t stat.)
US	0.221	(1.06)	0.740	(0.96)	0.740	(0.96)
KR	−0.115	(−1.23)	0.558	(0.73)	1.298	(1.82)
CH						
TW	−0.055	(−0.60)	0.023	(0.03)	0.763	(0.85)
HK						
TH	−0.009	(−0.08)	−0.332	(−0.39)	0.408	(0.43)
SI						
ML						
PH						
IN						
GR						
A-R2:	0.180		Smpl:	91		

Pneumatic tires for bicycles (4011420)

	Alpha		Beta		(US+Country dummy)	
	Coef.	(t stat.)	Coef.	(t stat.)	Coef.	(t stat.)
US	−0.678	(−2.03)*	1.554	(1.42)	1.554	(1.42)
KR						
CH						
TW						
HK	−0.118	(−0.81)	0.706	(0.61)	2.260	(2.12)*
TH	0.107	(0.69)	−2.004	(−1.56)	−0.450	(−0.37)
SI	−0.034	(−0.24)	0.053	(0.04)	1.607	(1.36)
ML						
PH						
IN						
GR	−0.084	(−0.61)	−0.449	(−0.35)	1.105	(1.04)
A-R2:	0.063		Smpl:	122		

Golf balls (9706051)

	Alpha		Beta		(US+Country dummy)	
	Coef.	(t stat.)	Coef.	(t stat.)	Coef.	(t stat.)
US	−0.058	(−0.18)	1.415	(1.44)	1.415	(1.44)
KR	−0.102	(−0.68)	0.401	(0.34)	1.816	(1.95)
CH						
TW	−0.098	(−0.68)	1.331	(1.06)	2.746	(2.41)*
HK	−0.050	(−0.34)	0.085	(0.07)	1.500	(1.52)
TH	−0.098	(−0.62)	0.882	(0.69)	2.297	(1.99)*
SI	−0.068	(−0.48)	1.139	(0.95)	2.554	(2.37)*
ML						
PH						
IN						
GR	0.028	(0.19)	0.45	(0.34)	1.865	(1.72)
A-R2:	0.528		Smpl:	158		

Fishing hooks (9707020)

	Alpha		Beta		(US+Country dummy)	
	Coef.	(t stat.)	Coef.	(t stat.)	Coef.	(t stat.)
US	0.001	(0.00)	0.942	(0.43)	0.942	(0.43)
KR	0.019	(0.05)	−0.316	(−0.11)	0.626	(0.30)
CH						
TW	0.074	(0.21)	−1.775	(−0.59)	−0.833	(−0.32)
HK	−0.010	(−0.03)	−0.139	(−0.05)	0.803	(0.34)
TH	0.065	(0.17)	−0.635	(−0.21)	0.307	(0.12)
SI	−0.102	(−0.29)	2.229	(0.77)	3.171	(1.32)
ML	−0.026	(−0.07)	−0.655	(−0.23)	0.287	(0.13)
PH	−0.030	(−0.08)	0.410	(0.16)	1.352	(0.74)
IN	−0.689	(−1.80)	0.783	(0.34)	1.725	(1.77)
GR	−0.126	(−0.38)	1.105	(0.37)	2.048	(0.89)
A-R2:	−0.066		Smpl:	220		

Portland cement (2523010)

	Alpha		Beta		(US+Country dummy)	
	Coef.	(t stat.)	Coef.	(t stat.)	Coef.	(t stat.)
US	0.069	(0.11)	2.558	(1.17)	2.558	(1.17)
KR						
CH						
TW	−0.168	(−0.83)	−3.775	(−1.94)	−1.217	(−0.50)
HK	−0.040	(−0.19)	−2.357	(−1.35)	0.201	(0.10)
TH						
SI	−0.081	(−0.40)	−2.074	(−1.14)	0.485	(0.21)
ML						
PH						
IN						
GR						
A-R2:	−0.104		Smpl:	91		

Aluminum foil (7604000)

	Alpha		Beta		(US+Country dummy)	
	Coef.	(t stat.)	Coef.	(t stat.)	Coef.	(t stat.)
US	0.151	(0.78)	0.628	(0.88)	0.628	(0.88)
KR	−0.107	(−0.93)	0.976	(1.08)	1.605	(2.38)*
CH	−0.061	(−0.53)	0.750	(0.94)	1.378	(2.81)**
TW	−0.074	(−0.68)	1.217	(1.24)	1.846	(2.26)*
HK	−0.011	(−0.10)	0.854	(0.95)	1.482	(2.12)*
TH	−0.077	(−0.64)	1.008	(1.02)	1.637	(1.99)*
SI	0.007	(0.07)	−0.019	(−0.02)	0.610	(0.79)
ML	−0.065	(−0.31)	0.647	(0.71)	1.275	(1.80)
PH	−0.065	(−0.54)	0.768	(0.91)	1.396	(2.43)*
IN	−0.067	(−0.57)	0.713	(0.95)	1.341	(4.37)**
GR	−0.030	(−0.27)	0.133	(0.14)	0.762	(1.04)
A-R2:	0.064		Smpl:	268		

Color film (3702092)

	Alpha		Beta		(US+Country dummy)	
	Coef.	(t stat.)	Coef.	(t stat.)	Coef.	(t stat.)
US	0.005	(0.02)	1.544	(2.02)*	1.544	(2.02)*
KR	0.024	(0.19)	−0.246	(−0.25)	1.298	(1.79)
CH	−0.085	(−0.69)	−0.102	(−0.12)	1.442	(2.75)**
TW	0.013	(0.11)	−0.053	(−0.05)	1.490	(1.70)
HK	−0.021	(−0.17)	0.301	(0.31)	1.845	(2.45)*
TH	0.074	(0.59)	−1.185	(−1.12)	0.359	(0.41)
SI	0.039	(0.34)	−0.935	(−0.93)	0.609	(0.74)
ML	0.062	(0.52)	−0.931	(−0.96)	0.613	(0.81)
PH						
IN	0.054	(0.43)	−0.824	(−1.02)	0.720	(2.20)*
GR	0.071	(0.62)	−0.786	(−0.76)	0.758	(0.97)
A-R2:	0.330	**	Smpl:	243		

Color photopaper (3703010)

	Alpha		Beta		(US+Country dummy)	
	Coef.	(t stat.)	Coef.	(t stat.)	Coef.	(t stat.)
US	−0.378	(−1.07)	−0.334	(−0.29)	−0.334	(−0.29)
KR	−0.032	(−0.17)	1.459	(0.99)	1.125	(1.02)
CH	−0.081	(−0.43)	2.032	(1.56)	1.698	(2.11)*
TW	0.102	(0.57)	−1.036	(−0.65)	−1.371	(−1.02)
HK	0.146	(0.79)	−1.168	(−0.80)	−1.503	(−1.31)
TH	0.127	(0.66)	−0.567	(−0.35)	−0.901	(−0.67)
SI	0.009	(0.05)	0.136	(0.09)	−0.198	(−0.16)
ML	0.013	(0.07)	0.930	(0.63)	0.596	(0.51)
PH						
IN	−0.005	(−0.02)	1.524	(1.24)	1.189	(2.37)*
GR	−0.078	(−0.44)	0.828	(0.53)	0.493	(0.41)
A-R2:	0.173		Smpl:	243		

Auto (8702191)

	Alpha		Beta		(US+Country dummy)	
	Coef.	(t stat.)	Coef.	(t stat.)	Coef.	(t stat.)
US	−0.402	(−1.95)	−0.312	(−0.46)	−0.312	(−0.46)
KR						
CH						
TW						
HK	0.005	(0.06)	0.373	(0.52)	0.062	(0.09)
TH						
SI	−0.041	(−0.47)	0.518	(0.69)	0.207	(0.28)
ML	0.057	(0.64)	0.189	(0.26)	−0.122	(−0.19)
PH						
IN						
GR	−0.010	(−0.11)	0.481	(0.60)	0.170	(0.26)
A-R2:	−0.047		Smpl:	122		

Autos 1.1-2 L engine (8702192)

	Alpha		Beta		(US+Country dummy)	
	Coef.	(t stat.)	Coef.	(t stat.)	Coef.	(t stat.)
US	0.081	(0.49)	0.233	(0.51)	0.233	(0.51)
KR						
CH	0.001	(0.02)	0.437	(0.86)	0.670	(2.13)*
TW	0.024	(0.35)	−0.937	(−1.52)	−0.704	(−1.34)
HK	−0.011	(−0.16)	0.368	(0.65)	0.601	(1.33)
TH	−0.050	(−0.67)	0.352	(0.56)	0.585	(1.10)
SI	−0.026	(−0.38)	0.526	(0.89)	0.759	(1.53)
ML	0.074	(1.04)	−0.870	(−1.52)	−0.637	(−1.40)
PH						
IN	0.001	(0.01)	0.469	(0.97)	0.702	(3.60)**
GR	−0.021	(−0.31)	0.288	(0.47)	0.521	(1.11)
A-R2:	0.130		Smpl:	218		

Autos over 2L engine (8702193)

	Alpha		Beta		(US+Country dummy)	
	Coef.	(t stat.)	Coef.	(t stat.)	Coef.	(t stat.)
US	0.052	(0.09)	−0.795	(−0.46)	−0.795	(−0.46)
KR						
CH	0.004	(0.02)	0.903	(0.48)	0.108	(0.09)
TW	−0.026	(−0.10)	0.586	(0.24)	−0.209	(−0.10)
HK	0.011	(0.04)	0.290	(0.14)	−0.505	(−0.30)
TH	0.079	(0.28)	−0.251	(−0.11)	−1.046	(−0.53)
SI	−0.040	(−0.16)	0.368	(0.17)	−0.428	(−0.23)
ML	0.030	(0.12)	0.027	(0.01)	−0.769	(−0.45)
PH						
IN	0.468	(1.69)	−1.609	(−0.89)	−2.405	(−3.31)**
GR	−0.007	(−0.03)	−0.339	(−0.15)	−1.134	(−0.65)
A-R2:	−0.032		Smpl:	216		

elasticity. The results are summarized in following points.

First, none of the β's are significant at 1% level. This means that U.S. import prices of those 11 goods were not affected by Japanese yen rates. Only in the case of small size autos (Color film (3702092)), the coefficient of U.S. is positive and significant at 5% level. The lack of significance also indicates that Japanese exporters set prices of goods shipped to the U.S. in U.S. dollars, i.e., they exercised PTM behavior. This is consistent with previous empirical evidences.

Second, in golf balls, Aluminum foil and Color film, more than three coefficients are positive and significant, whose coefficients are bigger than the coefficients of same countries in the other goods. For golf balls, the pass-through elasticity follows this order:

US < HK < KR < GR < TH < SI < TW

The smaller is the elasticity, the more competitive the market may be. The elasticity of U.S. is the smallest. This means that Japanese exporters set the most stable prices for the U.S. market

because that market is the most competitive.

For aluminum foil, the elasticity follows this order:

SI＜US＜GR＜ML＜IN＜CH＜PH＜HK＜KR＜TW

The elasticity of the U.S. is the second smallest, and the elasticity of GR is the third smallest for aluminum foil. These results seem to reflect the fact that the U.S. and Germany are more competitive markets for Japanese exporters.

For color film, the elasticity follows this order:

TH＜SI＜ML＜GR＜KR＜CH＜TW＜US＜HK

The order in the case of color film is different from those of golf balls and aluminum foil. In this case, Thailand is the most competitive and U.S. is not so competitive for Japanese exporters.

6. Conclusion

This paper examined the pass-through of exchange rates on import prices in Asian countries. Empirical analyses using aggregated data revealed that the U.S. dollar affected the import prices of almost all the countries except Singapore, but that the Japanese yen had no such effect. Empirical analyses using disaggregate data found that the import prices of 3 goods (golf balls, aluminum foil and color film) out of 11 were affected by yen rates. Although the sample sizes were small, this evidence does suggest that the degree of pass-through differs by the type of good and that, in sum, the yen did not affect the import prices of Asian countries.

Devereux and Engel (1988) find that when prices are set in consumers' currency, floating exchange rates always dominate fixed exchange rates. When prices are set in producers' currency, there is a trade-off between floating and fixed exchange rates.

The simple analysis of this paper shows that U.S. exporters set the price in producers' currency, and Japanese exporters set the price in consumers' currency. These results indicate that, if trade partner was only U.S., fixing a home currency to the U.S. dollar is better than floating exchange rates in a situation of volatile exchange rates, while if trade partner was only Japan, floating exchange rates is better than fixed exchange rate regime. But, actually East Asian countries export to and import from both U.S. and Japan. Thus we can't know which regime is better for East Asian countries from the recent literature. The only thing that this analysis implicates is that dollar peg regime is not adequate for Asian countries because Japanese Yen rates are not adjusted to stabilize consumption under dollar peg regime and probably volatility of Japanese Yen would make fundamentals of Asian countries unstable.

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