97-F-6

International Price Linkage within a Region: The Case of East Asia

Shin-ichi Fukuda
Faculty of Economics
University of Tokyo

Takashi Kano
Hitotsubashi University

January 1997

International Price Linkage within a Region : The Case of East Asia

By

Shin-ichi Fukuda
Faculty of Economics, The University of Tokyo
7-3-1 Hongo Bunkyo-ku Tokyo 113 Japan
email: sfukuda@e.u-tokyo.ac.jp

and

Takashi Kano
Research Fellow of the Japan Society for the Promotion of Science
Graduate School of Economics, Hitotsubashi University
2-1 Naka Kunitachi Tokyo 186 Japan
email: t-kano@apple.ifnet.or.jp

January, 1996

Abstract

This paper investigates how "prices" in East Asian economies were correlated with those in Japan and with those in the United States. The analysis is particularly noteworthy because East Asian economies are geographically close to Japan but their currencies have been more tied to the US dollar. In the paper, we analyze two different types of "prices" : the overall price levels in terms of the same currency and the relative prices among different commodities. We demonstrate that the overall price levels in East Asian economies were closely related to those in the United States. However, we also show that the relative prices in East Asian economies, especially those in Taiwan and Korea, were closely correlated with those in Japan. The results are in marked contrast with the price correlation in other regions.

---

* An earlier version of this paper was presented at the NBER-TCER-CEPR conference *Purchasing Power Parity Revisited: The Exchange Rate and Price Movements, Theory and Evidence.* We would like to thank K. Ohno, E. Ogawa and other seminar participants for their helpful comments. This project was funded by a grant from Tokyo-Mitsubishi Seimeikai. The usual disclaimer applies.

1. Introduction

The failure of the law of one price in international trade has been widely documented. One well-understood explanation for this failure is the Balassa (1964) - Samuelson (1964) effect which stresses the differential productivity growth between tradable and non-tradable sectors. It has also been argued that demand factors can lead to changing relative prices of the non-tradable goods (Froot and Rogoff, (1991), De Gregorio, Giovannini, and Wolf (1994)). However, previous empirical evidence showed that even within the category of tradable goods, the law of one price can fail across countries (Isard (1977), Giovannini (1988)). In particular, Engel (1993) and Rogers and Jenkins (1995) found that the short-run variance of real exchange rate is mainly explained by changes in the relative price for traded goods .

Recent studies have focused on the natures of such failures of the law of one price. One well accepted explanation is that of short-term price rigidities, due, say, to menu costs in changing prices (Mussa (1986), Ghosh and Wolf (1994)). The large empirical studies on pricing-to-market may present another explanation (see, among others, Knetter (1989), Marston (1990), Ohno (1989)).

On the other hand, Engel and Rogers (1994) found that national borders are a significant contributor to cross-country price variability beyond transporting costs. They also showed that the variability in the price of goods in two different locations depends on the distance between locations, as in gravity models of trade (see also Wei and Parsley (1995)). In addition, Engel and Rogers (1995) found that the law of one price holds more nearly for country pairs that are within geographic regions than the country pairs that are not.

There are several reasons why there may be smaller price disparities intraregionally than interregionally. First, two locations within a region are usually closer together than two locations in different regions. When goods are costly to transport between locations, arbitrage may not fully equalize prices. Since two locations within a region are geographically close, shipping costs within a region are smaller. Second, two locations within a region frequently form free trade areas, customs unions or common markets and may share common distribution systems. The absence of trade barriers clearly could help to explain why the law of one price holds more nearly within regions. Third, the nominal exchange rate between locations within a region is usually less variable. Thus, if the nominal prices are sticky in the currency of the country in which the final goods is sold, price disparities are smaller intraregionally than interregionally.

The purpose of this paper is to examine the nature of the deviations from the law of

one price in an East Asian "region". In particular, we investigate how "prices" in East Asian economies (that is, Korea, Taiwan, Hong Kong, Singapore, Malaysia, Indonesia, Thailand, and the Philippines) were correlated with those in Japan and with those in the United States. The analysis of "prices" in East Asian economies is particularly noteworthy for several reasons.

First of all, East Asian economies are geographically closer to Japan than to the United States. Thus, if the spread of the cross-border prices is explained by the geographical distance between countries, the law of one price would hold more nearly between Japan and East Asian economies than between the United States and East Asian economies. Second, Japan as well as the United States are the biggest trade partners for East Asian economies, especially in their imports (see Table 1). In addition, the amount of direct investment from Japan to East Asian economies has drastically increased during the last decade (see Table 2). These factors can also make the law of one price hold more nearly between Japan and East Asian economies.

However, East Asian currencies have traditionally been more tied to the US dollar than to the Japanese yen. Among East Asian economies, Hong Kong have been pegging its currency to the US dollar since the mid 1980s. On the other hand, most of other East Asian currencies have adopted the basket system to peg their currencies. Although the composition of the basket is not officially announced, it is well known that East Asian currencies have been strongly tied to the US dollar and that the weight of the yen has not been significant (see Frankel (1991) and Frankel and Wei (1993)). In addition, the US dollar is still a dominant invoice currency in East Asian foreign trade (see, for example, Tavlas and Ozeki (1992) , Ito (1993), Fukuda and Ji (1995), Kawai (1996)). If the price of a consumer good might be sticky in local currency, these factors probably imply that the cross-border prices would fluctuate large between East Asia and Japan, but would be stable between East Asia and the United States.

In this paper, we analyze two different types of "prices". One is overall price levels in terms of the same currency. Using both consumer price and wholesale price indexes, we investigate how the overall price levels are correlated across countries. Needless to say, the correlation needs to be one if PPP holds exactly. The other is relative prices between different commodities within a country. Constructing the relative prices through dividing each commodity's price index by the overall price index, we explore how the relative prices move together across countries. Since the nominal exchange rate does not appear in the construction, the relative prices are not directly related to the issues on PPP. However, the cross-country correlation of the relative prices can be another good indicator to see how prices are linked internationally.

In our empirical results, we demonstrate that the overall price levels in East Asian economies were closely related to those in the United States. However, we also show that the relative prices in East Asian economies, especially in Taiwan and Korea, were closely correlated to those in Japan. The results are in marked contrast with the price correlation in other regions. For example, in north America, prices in Canada have had strong linkage with those in the United States both in the overall price levels and in the relative prices. A similar result will probably hold true among European countries. Thus, our results imply that East Asian economies have had a special international price linkage with Japan and the United States.

There are several previous studies which investigated price linkage in East Asia. Among others, Goto and Hamada (1994) applied principal component analysis to evaluate the degree of confluence of consumer price changes within East Asia. Similarly, Taguchi (1994) and Kawai and Okumura (1996) examined intraregional correlation of domestic inflation rates in East Asia. However, they focused neither on the issues on PPP nor on the international linkage of the domestic relative prices.

The paper proceeds as follows. The next section shows that the real exchange rates of East Asian economies were more stable to the United States than to Japan during the post-Bretton-Woods period. Section 3 extends this result by examining the stability of the East Asian real exchange rates after 1987 and during the Bretton-Woods period. Section 4 shows that the relative prices in East Asian economies were more closely correlated with those in Japan rather than with those in the United States. Section 5 tentatively considers why the relative prices, but not the overall price levels, have had a strong linkage between East Asian economies and Japan. Section 6 summarizes our main results and refers to a possible extension.

2. Real Exchange Rates in East Asia

This section investigates the behavior of real exchange rates for eight East Asian economies (that is, Korea, Taiwan, Hong Kong, Singapore, Malaysia, Indonesia, Thailand, and the Philippines). Specifically, we examine whether real exchange rates of these East Asian economies are more stable to Japan or to the United States. The series in calculating real exchange rates consist of the overall consumer price and overall wholesale price indexes. The price data are monthly, beginning in April 1973 and running to March 1996 in CPI and to December 1995 in WPI.[1] These

---

[1] The WPI data in Hong Kong is not available. The WPI in Singapore starts from January 1974 and the WPI data in Malaysia starts from January 1986.

periods correspond to the time in which the yen/dollar nominal exchange rate was floating.

Before discussing the stability of real exchange rates, we first examined whether real exchange rates are stationary in East Asian economies. As is well known, individual tests on nominal exchange rates and price levels usually reveal the presence of a unit root, i.e. that they are integrated of order 1 [I(1)]. However, if PPP holds exactly, the real exchange rate is a stationary series with a mean equal to zero. In addition, given that price levels in terms of the same currency unit are I(1), a necessary condition for PPP is that these price levels are cointegrated.[2]

We first applied the unit root tests to real exchange rates of East Asian economies in terms of the US dollar and in terms of the Japanese yen. For the log of the real exchange rates, we performed three different types of unit root tests : the Augmented Dickey-Fuller (tau) by Dickey and Fuller (1979), Phillips-Perron (Z) by Phillips and Perron (1988), and Weighted Symmetric (Pantula et al. (1994)). In any type of test, test statistics was computed both with and without time trend. In addition, we selected the number of lags so as to maximize AIC2 in each test.

Table 3 reports the results of our unit root tests. Regardless of the choice of price index or time trend, almost all of unit root tests could not reject the null hypothesis that the real exchange rates have a unit root for eight East Asian economies. That is, in the case of CPI, we could not reject the null hypothesis at 10% significance level except for one case (i.e., the Weighted Symmetric test with trend for Taiwan's real exchange rates in terms of the Japanese yen). In the case of WPI, the results were slightly modest. For example, we could reject the null hypothesis at 5% significance level for all unit root tests in Philippine real exchange rates in terms of the Japanese yen without trend and in Philippine real exchange rates in terms of the US dollar with trend. However, even in the case of WPI, almost all of other tests could not reject the null hypothesis that the real exchange rates have a unit root at reasonable significance level. Thus, we can generally conclude that PPP does not hold in East Asian economies in the sense that real exchange rates are not stationary both in terms of the US dollar and in terms of the Japanese yen.

However, even if (the log of) the real exchange rate has a unit root, the degrees of deviations from PPP can be different depending on whether we measure it in terms of the US dollar or in terms of the Japanese yen. To see this, we calculated both the

---

2 For a broad survey on previous studies which investigated the stationarity of real exchange rates, see section 2 in Froot and Rogoff (1994).

unconditional and conditional variances of real exchange rates in terms of both the US dollar and the Japanese yen for eight East Asian economies. In calculating the variances of the logged real exchange rates, we used their first-differences because they have a unit root.

We examined the unconditional variance of a series because it may capture the long-term volatility of real exchange rates. However, in order to capture the short- to medium-term volatility of real exchange rates, we also measured the variance of the news about the series. Specifically, we estimated sixth-order autoregressions for the first-difference of each logged real exchange rate and then calculated the volatility measure as the variance of its forecast error.

Table 4 reports the calculated variances of the real exchange rates. For all CPI's and WPI's, the variances in terms of the US dollar were smaller than those in terms of the Japanese yen both in the unconditional and conditional variances. For most cases, the variances in terms of the Japanese yen were more than double of those in terms of the US dollar. In particular, for CPI's in Korea, Hong Kong, and Singapore, the real exchange rates in terms of the Japanese yen fluctuated more than four times as large as those in terms of the US dollar. Thus, we can see that for all East Asian economies, the degrees of deviations from PPP were much smaller in terms of the US dollar than in terms of the Japanese yen.

The above results imply that in East Asian economies, the geographical distance between countries is not a key factor in explaining the spread of the cross-border price levels. Instead, noting that East Asian currencies have been strongly tied to the US dollar, sticky prices of final goods in local currency can explain well the degrees of deviations from PPP. It is noteworthy that the result similarly holds well even in a small open economy such as Hong Kong and Singapore. This indicates that even if tariff rates and non-tariff barriers are negligible, there is little evidence of price arbitrage in final goods.[3]

3. Real Exchange Rates during Alternative Periods

---

[3] Lee and Swagel (1994) reported tariff rates and non-tariff barriers in various countries. According to their report, both tariff rates and non-tariff barriers are zero in Hong Kong, tariff rates range from 0.6 to 0.9 and non-tariff barriers 1.1 to 1.2 in Singapore. These figures are much lower than those of OECD countries. For example, they reported that tariff rates range from 4.5 to 4.9 and non-tariff barriers from 26.6 to 37.5 in the United States.

In the last section, we showed that real exchange rates of East Asian economies were more stable to the United States than to Japan during the post-Bretton-Woods period when the yen/dollar nominal exchange rate was floating. This section investigates the validity of the results by extending the analysis to two directions.

First, we examined the stability of the East Asian real exchange rates after 1987. We picked up this sample period because during this period, the economic linkage between East Asia and Japan has increased a lot, especially in direct investment from Japan (see Table 3). For this short sample period, the unit root tests may not be powerful in general. However, almost all of our unit root tests could not reject the null hypothesis that the logged real exchange rates have a unit root in eight East Asian economies. Thus, taking their first-differences, we calculated both the unconditional and conditional variances of real exchange rates in terms of both the US dollar and the Japanese yen.[4]

Table 5 reports the computed variances of the real exchange rates. Both in the unconditional and conditional variances, the variances in terms of the Japanese yen were larger than those in terms of the US dollar in all East Asian economies. In particular, we can see that the variances in terms of the Japanese yen are almost the same as those in Table 4 but that the variances in terms of the US dollar are smaller than those in Table 4. This indicates that after the mid 1980s, the degrees of deviation from PPP became relatively larger in terms of the Japanese yen rather than in terms of the US dollar for all East Asian economies.

Our second extension is to examine the stability of the East Asian real exchange rates during the Bretton-Woods period. This period corresponds to the time in which the yen/dollar nominal exchange rate was fixed.[5] If the nominal exchange volatility is a key contributor to deviations from PPP, we would find no significant difference in the stability between East Asian real exchange rates in terms of the US dollar and those in terms of the Japanese yen. Unless specified, the sample period is from January 1957 through July 1971. Depending on the availability of the data, we examined the relative stability of the real exchange rates for six East Asian economies (that is, Korea, Taiwan, Singapore, Malaysia, Thailand, and the Philippines).

We first applied the unit root tests to the logged real exchange rates of East Asian

---

4 The method of calculating the conditional variances is the same as that in the last section.

5 During this period, the nominal exchange rates in East Asian economies were also fixed to the US dollar except for infrequent changes in the official parity.

economies.[6] Table 6 reports the results of our unit root tests. In the case of WPI, any type of unit root tests could not reject the null hypothesis that real exchange rates in terms of the US dollar and the Japanese yen have a unit root in eight East Asian economies. Similarly, in the case of CPI, all unit root tests could not reject the null hypothesis except for two cases (i.e. Phillips- Perron tests for Malaysian rates in terms of the yen with trend and for Singapore's rates in terms of the yen with trend). Thus, even during the Bretton-Woods period, we can generally conclude that PPP does not exactly hold in East Asian economies in the sense that real exchange rates are not stationary both in terms of the US dollar and in terms of the Japanese yen.

We next calculated both the unconditional and conditional variances of real exchange rates in terms of both the US dollar and the Japanese yen for eight East Asian economies. In calculating the variances of the logged real exchange rates, we used their first-differences because the logged real exchange rates have a unit root. In calculating their conditional variances, we estimated sixth-order autoregressions for the first-difference of each logged real exchange rate.

Table 7 reports the calculated variances of the real exchange rates. When we used CPI, the variances of real exchange rates in terms of the US dollar were still smaller than those in terms of the Japanese yen in Malaysia and Singapore. However, in other cases of CPI and in all cases of WPI, the variances of the real exchange rates in terms of the US dollar were as large as those in terms of the Japanese yen. Thus, we can conclude that during the Bretton-Woods period, the degrees of deviations from PPP in terms of the US dollar were as big as those in terms of the Japanese yen for almost all East Asian economies.

4. International Linkage of Relative Prices

In the last two sections, we showed that when the yen/dollar nominal exchange rate was floating, the real exchange rates of East Asian economies were more stable to the United States rather than to Japan. We also showed that when the yen/dollar nominal exchange rate was fixed, the real exchange rates in East Asian economies were almost equally stable to the United States and to Japan. These results imply that the volatility of nominal exchange rates was a significant contributor to cross-country price variability in East Asian economies during the post-Bretton-Woods period. However, these results do not imply that besides the effects of nominal exchange rate volatility,

---

[6] In any type of test, test statistics was computed both with and without time trend. In addition, we selected the number of lags so as to maximize AIC2.

East Asian economies have had stronger "price" linkage to the US economy rather than to the Japanese economy.

The purpose of this section is to analyze whether relative prices among different commodities in East Asian economies were more similar to those in the United States than to those in Japan. The analysis is particularly noteworthy because we do not use nominal exchange rates to calculate relative prices within a country. If the price of a consumer good is simply sticky in local currency, the analysis would not find any special relationship among the relative prices of different countries. However, if there is some "price" linkage across borders, the analysis may find some correlations of the relative prices.

In the analysis, we calculated the relative prices among different commodities for eight East Asian economies, the United States, and Japan. We then examined whether the relative prices in the East Asian economies are more closely correlated with those in the United States or with those in Japan. We constructed each relative price through dividing each commodity's price index by the overall price index within a country. Specifically, for each commodity j and country k, we defined the relative price by

$$q_i^k = log(p_i^k/p^k),$$

where p_i^k is the commodity i's price index in country k and p^k is the overall price index in country k.

We regressed the commodity i's relative price in each East Asian economy k, q_i^k, on the corresponding relative prices in Japan and the United States, q_i^{JAPAN} and q_i^{USA} as follows:

$$q_i^k = \text{constant} + a^* q_i^{JAPAN} + b^* q_i^{USA},$$

In the regression, we included a time trend, if any, and used the ML method if disturbances display the first-order serial correlation.[7] The data are annual price indexes for the overall consumer price and wholesale price indexes and their sub-categories. Unless specified, the sample period is from 1970 to 1994.

Table 8 reports the results of our regression. One striking result is that the relative prices in East Asian economies tended to be more closely correlated with those in Japan rather than with those in the United States. The tendency was most

---

[7] We also included a squared time trend, if any.

conspicuous in Taiwan and Korea for which a number of subcategories are available. That is, for the Taiwan's relative prices, the coefficient of the Japan's relative price was much greater than that of the US relative price in seven of nine WPI commodities and in all of three CPI commodities. For the Korea's relative prices, the coefficient of the Japan's relative price was significantly greater than that of the US relative price in ten of thirteen WPI commodities and in three of four CPI commodities.

The tendency was essentially the same in the Philippine price indexes and the Thailand's WPI, although the estimated coefficients were less statistically significant. That is, for the Philippine relative prices, the coefficient of the Japan's relative price was greater than that of the US relative price in all of two WPI commodities and in two of three CPI commodities. For Thailand's WPI, the coefficient of the Japan's relative price was significantly greater than that of the US relative price in four of six commodities.

The tendency was less clear in Hong Kong, Singapore, Indonesia, Malaysia, and Thailand's CPI. In particular, except for Thailand's CPI, the relative prices of food in CPI were more correlated with those in the United States rather than those in Japan. However, even in these economies, our overall results show that the coefficients of the US relative prices never dominate those of the Japan's relative prices. In addition, most of the estimated results were not statistically significant. We conjecture that the less significant estimations may have occurred because price indexes have large measurement errors in these economies. In fact, for these economies, the numbers of sub-categories we could obtain were very limited.

5. Interpretations

In previous sections, we showed that the overall price levels in East Asian economies were closely related to those in the United States. However, we also demonstrated that the relative prices in East Asian economies, especially in Taiwan and Korea, were closely correlated with those in Japan. These results look in marked contrast with price correlation in other regions. For example, in north America, prices in Canada have had strong linkage with those in the United States not only in the overall price levels but also in the relative prices.

Table 9 shows this for six selected commodities (that is, food, textile, wood, paper, non-metal, and basic metal). As in the last section, we regressed each commodity's relative price in Canada on the corresponding commodity's relative prices

in Japan and the United States.[8] The data are monthly price indexes for the overall wholesale prices and their sub-categories from January 1975 to October 1994. Not surprisingly, the results in the table show that the relative prices in Canada were more closely correlated with those in the United States rather than with those in Japan. Since the overall price levels in Canada have also strong linkage with those in the United States, this implies that prices in Canada have had strong linkage with those in the United States both in the overall price levels and in the relative prices.

The result, however, leads to a question why the relative prices, but not the overall price levels, have had a strong economic linkage between East Asia and Japan. The first possible answer is that East Asian economies and Japan have a similar economic structure, including similar endowments and preferences. In this case, their autarky relative price structure can be similar. Thus, even without any overall price arbitrage, the relative prices in East Asia can have had a strong correlation with those in Japan.

The second possible answer is that prices adjust to the nominal exchange rate changes with a very low speed but the adjustment speeds are almost the same for most of commodities. In this case, the overall price levels are not equalized across the national borders for a long time. However, the relative prices can move together across the borders.

The third possible answer is that there exist little price arbitrage in final goods but large price linkage in intermediate goods between Japan and East Asian economies. Without price arbitrage in final goods, it is natural that the overall price levels are not equalized across the national borders. However, if prices of intermediate goods are correlated, it is possible that the relative prices move together across the borders.

6. Concluding Remarks

Not a few previous studies concluded that the law of one price holds more nearly for country pairs that are within geographic regions than the country pairs that are not because of transporting costs. The results of our paper showed that this conclusion does not carry through to the overall price levels in East Asian economies. That is, real exchange rates of East Asian economies were more stable to the United States rather than to Japan during the post-Bretton-Woods period. However, our results also showed that East Asian relative prices among different commodities were more

---

8 We also included a constant term and a time trend, if any, and used the ML method if disturbances display serial correlation.

correlated with those in Japan rather than with those in the United States. The results are inconsistent with a simple story of price rigidities due to menu costs because the price rigidities hardly explain international correlation of relative prices among different commodities. They are also inconsistent with the Balassa-Samuelson effect because the deviations from PPP were large among countries where their relative prices within countries moved similarly.

Of course, our results say little about why the relative prices, but not the overall price levels, have had a strong correlation between East Asia and Japan. Theoretically, various types of answers are possible. Under one extreme situation, the relative prices may have a strong correlation because the autarky relative price structures are similar between East Asia and Japan. In this case, our results do not necessarily imply any causal international price linkage between East Asia and Japan. However, without direct price linkage, similar autarky relative price structures tend to be formed through various indirect economic linkage among countries. Thus, even if the correlation comes from the similarity in their autarky relative price structures, it is consistent with the indirect price linkage between East Asia and Japan.

In addition, there exist various another possible answers. For example, suppose that price arbitrage in final goods is small but price linkage in intermediate goods is large. Without price arbitrage in final goods, it is natural that the overall price levels are not equalized across national borders. However, if prices of intermediate goods are correlated, it is possible that the relative prices move together across borders. Theoretically, cross-border price arbitrage is more likely to be undertaken at the intermediate goods level than at the consumer goods level. Thus, the closer together two regions are, the less dispersion is likely in the intermediate goods prices. Needless to say, this possible explanation needs formal empirical studies by using detailed data.

Data Appendix

Except for sub-categories of price indexes, all data of price indexes and exchange rates are taken from International Financial Statistics, IMF, various issues, and Financial Statistics, Taiwan District, The Republic of China, The Central Bank of China, various issues.

Sources of sub-categories of price indexes for each country are as follows:

(1) USA: Statistical Abstract of the United States, US Department of Commerce, Economics and Statistics Administration Bureau of the Census, various issues.

(2) Japan: Annual Report on the Consumer Price Index, Statistics Bureau, Management and Coordination Agency, Government of Japan. Price Indexes Annual, Research and Statistics Department, Bank of Japan.

(3) Korea: Price Statistics Summary, Bank of Korea. Economic Statistics Yearbook of Korea, Economic Research Institute of Korea.

(4) Taiwan: Statistical Yearbook of the Republic of China, Directorate-General of Budget, Accounting and Statistics, Executive Yuan, Republic of China.

(5) Singapore: Yearbook of Statistics Singapore, Department of Statistics, Singapore.

(6) Malaysia: Yearbook of Statistics Malaysia, Department of Statistics, Malaysia.

(7) Indonesia: Statistical Yearbook of Indonesia, BIRO PUSAT STATISTIK JAKARTA. Statistical Pocketbook of Indonesia, BIRO PUSAT STATISTIK JAKARTA.

(8) Thailand: Statistical Yearbook Thailand, National Statistical Office, Office of the Prime Minister.

(9) The Philippine: Philippine Statistical Yearbook, National Statistical Coordination Board, Philippine.

(10) Hong Kong and the others: Statistical Yearbook for Asia and The Pacific, the United Nations.

References

Balassa, Bela, (1964), "The Purchasing-Power Parity Doctrine: A Reappraisal" Journal of Political Economy pp.584-596.

De Gregorio, Jose, Alberto Giovannini, and Holger Wolf, (1994), "International Evidence on Tradables and Nontradables Inflation," European Economic Review 38, pp.1225-1244.

Dickey, David, and Wayne A. Fuller, (1979), "Distribution of Estimators for Autoregressive Time Series with a Unit Root," Journal of American Statistical Association 83, pp.857-862.

Engel, Charles, (1993), "Real Exchange Rates and Relative Prices: An Empirical Investigation," Journal of Monetary Economics 32, pp.35-50.

Engel, Charles, and John H. Rogers, (1994), "How Wide is the Border?" NBER Working Paper #4829.

Engel, Charles, and John H. Rogers, (1995), "Regional Patterns in the Law of One Price: The Roles of Geography VS. Currencies" NBER Working Paper #5395.

Frankel, Jeffrey A., (1991), "Is a Yen Bloc Forming in Pacific Asia?" in R. Obrien and S. Hewin, eds., Finance and the International Economy, New York: Oxford University Press.

Frankel, Jeffrey A. and Shang-Jin Wei, (1993), "Yen Bloc or Dollar Bloc: Exchange Rate Policies of the East Asian Economies," in T. Ito and A.O. Krueger eds., Macroeconomic Linkage: Savings, Exchange Rates, and Capital Flows, Chicago: University of Chicago Press, pp.295-329.

Froot, Kenneth A., and Kenneth Rogoff, (1991), "The EMS, the EMU, and the Transition to a Common Currency," in S. Fischer and O. Blanchard, eds., NBER Macroeconomics Annual, Cambridge: MIT Press, pp.269-317.

Froot, Kenneth A., and Kenneth Rogoff, (1994), "Perspectives on PPP and Long-run Real Exchange Rates," NBER Working Paper # 4952.

Fukuda, Shin-ichi and Ji Cong, (1995), "On the Choice of Invoice Currency by Japanese Exporters: The PTM Approach," Journal of the Japanese and International Economies 8, pp.511-529.

Ghosh, Atish R., and Holger C. Wolf, (1994), "Pricing in International Markets: Lessons from the Economist, " NBER Working Paper #4806.

Giovannini, Albert, (1988), "Exchange Rates and Traded Goods Prices," Journal of International Economics 24, pp.45-68.

Goto, Junichi, and Koichi Hamada, (1993), "Economic Preconditions for Asian Regional

Integration," in T. Ito and A.O. Krueger eds., Macroeconomic Linkage: Savings, Exchange Rates, and Capital Flows, Chicago: University of Chicago Press, pp.359-385.

Isard, Peter, (1977), "How Far Can We Push the Law of One Price?" American Economic Review 67, pp.942-948.

Ito, Takatoshi, (1993), "The Yen and the International Monetary System," in C. F. Bergsten and N. Noland eds. Pacific Dynamism and the International Economic System, Washington D.C.: Institute of International Economies, pp.299-322.

Kawai, Masahiro, (1996), "The Japanese Yen as an International Currency: Performance and Prospects," in R. Sato and H. Hori eds., Organization, Performance, and Equity: Perspectives on the Japanese Economy, Boston: Kluwer Academic Publishers, pp.306-359.

Kawai, Masahiro, and Tsunao Okumura, (1996), "Macroeconomic Interdependence and the Scope for Policy Coordination in the Asia-Pacific Region," paper presented at "International Symposium on Macroeconomic Interdependence in the Asia-Pacific Region" on January 30-31, 1996 in Tokyo..

Knetter, M., (1989), "Price Discrimination by US and German Exporters," American Economic Review 79, pp.198-210.

Lee. Jong-Wha, and Phillip Swagel, (1994), "Trade Barriers and Trade Flows across Countries and Industries," NBER Working Paper #4799.

MacKinnon, James G., (1994), "Approximate Asymptotic Distribution Functions for Unit-Root and Cointegration Tests," Journal of Business & Economic Statistics 12, pp.167-176.

Marston, Richard C., (1990), "Pricing to Market in Japanese Manufacturing," Journal of International Economics, 29, pp.217-236.

Mussa, Michael, (1986), "Nominal Exchange Rate Regimes and the Behavior of Real Exchange Rates: Evidence and Implications," in K. Brunner and A. Meltzer eds., Carnegie-Rochester Conference Series on Public Policy 25, pp.117-214.

Ohno, Kenichi, (1989), "Export Pricing Behavior of Manufacturing: A US-Japan Comparison," IMF Staff Papers 36, pp.550-579.

Pantula, Sastry G., Graciela Gonzalez-Farias, and Wayne A. Fuller, (1994), "A Comparison of Unit-Root Test Criteria," Journal of Business & Economic Statistics 12, pp.449-459.

Phillips, P. C. B., and P. Perron (1988), "Testing for a Unit Root in a Time Series Regression," Biometrika 75, pp.335-346.

Rogers, John H., and Michael Jenkins, (1995), "Haircuts or Hysteresis? Sources of

Movements in Real Exchange Rates," Journal of International Economics 38, pp.339-360.

Samuelson, Paul A., (1964), "Theoretical Notes on Trade Problems," Review of Economics and Statistics 46, pp.145-164.

Taguchi, Hiroo, (1993), "On the Yen Block," in T. Ito and A.O. Krueger eds., Macroeconomic Linkage: Savings, Exchange Rates, and Capital Flows, Chicago: University of Chicago Press, pp.335-355.

Tavlas, George S., and Yuzuru Ozeki, (1992), The Japanese Yen as an International Currency, International Monetary Fund, Occasional Paper 90.

Wei, Shang-Jin, and David C. Parsley, (1995), "Purchasing Power Disparity During the Floating Rate Period: Exchange Rate Volatility, Trade Barriers, and Other Culprits," NBER Working Paper #5032.

Table 1 The Degrees of Trade Dependency on the USA and on Japan

For The U.S. (%)

	NIEs Total		Korea		Taiwan		Singapore		Hong Kong		ASEAN Total		Thailand		Philippines		Indonesia		Malaysia	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
1981	26.2	16.9	26.8	23.2	36.1	22.5	13.2	12.6	27.8	10.4	17.7	15.5	12.9	13.0	31.0	22.8	18.3	13.5	13.1	14.6
1986	37.2	16.1	40.0	20.7	47.7	22.5	23.3	15.0	31.3	8.4	20.1	17.0	18.1	14.3	35.6	24.8	19.6	7.2	16.4	18.8
1991	24.5	16.4	25.8	23.2	29.3	22.5	19.8	15.8	22.7	7.6	18.4	13.8	21.2	10.5	35.9	20.8	12.0	13.2	17.0	15.3
1994	21.6	14.3	21.4	20.9	26.4	20.0	18.7	15.2	20.8	6.4	22.2	14.0	23.3	11.4	38.6	18.5	16.8	10.1	21.2	16.6

For Japan(%)

	NIEs Total		Korea		Taiwan		Singapore		Hong Kong		ASEAN Total		Thailand		Philippines		Indonesia		Malaysia	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
1981	10.50	23.30	16.50	24.40	10.90	28.00	10.10	18.80	4.70	23.10	33.40	25.00	14.20	24.30	21.90	19.00	47.90	30.10	21.10	24.40
1986	10.20	26.90	15.60	34.40	11.40	34.10	8.60	19.90	4.70	20.40	28.30	24.10	14.20	26.40	17.70	17.00	44.90	15.10	23.30	20.50
1991	10.50	22.70	17.20	25.90	12.10	30.00	8.70	21.40	5.40	16.40	22.90	26.10	17.90	29.10	20.20	20.00	36.90	24.50	15.90	26.10
1994	8.70	20.90	14.10	24.80	11.10	27.50	7.00	21.90	5.00	14.00	18.60	27.80	18.00	30.60	15.00	24.20	30.90	27.60	11.90	26.70

Sources) IMF, Direction of Trade Statistics, various issues.

Table 2 Sources of Inward Direct Investment in East Asian Economies

		Korea	Taiwan	Singapore	Hong Kong	Thailand	Philippines	Indonesia	Malaysia
1981	The U.S.	58.6	N/A	37.5	43.6	11.6	46.9	N/A	N/A
	Japan	23.8	N/A	18.3	31.5	20.9	8.1	N/A	N/A
1986	The U.S.	35.4	18.0	56.1	22.5	19.1	70.5	13.5	3.2
	Japan	38.9	32.9	49.0	19.6	20.5	8.5	49.9	10.7
1991	The U.S.	21.2	33.0	39.4	16.1	18.5	11.1	3.1	7.9
	Japan	16.2	29.6	29.0	44.0	23.2	26.9	10.6	20.9
1994	The U.S.	23.6	18.0	56.7	22.6	13.5	28.8	4.1	13.7
	Japan	32.5	24.0	21.1	51.3	46.8	4.4	6.6	17.1

Notes) 1. Figures in the table denote that the weights of the USA and Japan in the total inward direct investment to East Asian Economies.
2. The data in Hong Kong is based on surveys on manufafturing industry.

Sources) Jetro, White Paper, various issues.

Table 3 Unit Root Tests During the Post-Bretton-Woods Period

(1) CPI real exchange rates with no trend

country sample period		in the US dollar			in the Japanese yen		
		TestStat	P-value	lags	TestStat	P-value	lags
Korea 73:4-96:3	WS	-1.472	0.532	3	-1.739	0.338	3
	ADF	-1.611	0.478	3	-1.565	0.501	5
	PP	-4.033	0.535	3	-4.621	0.471	5
Hong Kong 73:4-96:3	WS	-0.563	0.945	4	-1.454	0.545	5
	ADF	-0.208	0.938	4	-2.030	0.273	5
	PP	-0.093	0.952	4	-4.323	0.503	5
Indonesia 73:4-96:3	WS	-1.173	0.736	3	-1.137	0.755	13
	ADF	-0.645	0.860	3	-0.976	0.762	13
	PP	-0.933	0.892	3	-0.914	0.894	13
Malaysia 73:4-96:3	WS	-1.146	0.751	4	-0.792	0.897	7
	ADF	-1.368	0.597	7	-1.285	0.636	7
	PP	-1.803	0.803	7	-1.494	0.837	7
the Philippines 73:4-96:3	WS	-1.906	0.237	11	-1.671	0.385	3
	ADF	-1.633	0.466	11	-1.535	0.516	3
	PP	-6.054	0.343	11	-3.867	0.553	3
Thailand 73:4-96:3	WS	-1.830	0.281	3	-1.144	0.752	3
	ADF	-1.505	0.531	3	-1.169	0.687	5
	PP	-3.343	0.616	3	-1.976	0.783	5
Singapore 73:4-96:3	WS	-1.406	0.580	7	-1.949	0.214	13
	ADF	-1.638	0.464	3	-1.997	0.288	13
	PP	-3.464	0.601	3	-3.901	0.550	13
Taiwan 73:4-96:3	WS	-1.949	0.214	13	-2.337	0.079	3
	ADF	-1.997	0.288	13	-2.139	0.229	3
	PP	-3.901	0.550	13	-7.559	0.243	3

(2) CPI real exchange rates with trend

country sample period		in the US dollar			in the Japanese yen		
		TestStat	P-value	lags	TestStat	P-value	lags
Korea 73:4-96:3	WS	-1.691	0.823	3	-2.699	0.186	3
	ADF	-1.625	0.782	3	-2.770	0.208	5
	PP	-4.170	0.877	3	-12.369	0.297	5
Hong Kong 73:4-96:3	WS	-0.450	0.995	4	-2.230	0.481	5
	ADF	0.226	0.996	4	-2.030	0.585	5
	PP	0.376	0.998	4	-7.936	0.589	5
Indonesia 73:4-96:3	WS	-0.727	0.988	3	-1.626	0.849	13
	ADF	-2.566	0.296	3	-2.679	0.245	13
	PP	-10.188	0.424	3	-12.158	0.308	13
Malaysia 73:4-96:3	WS	-1.853	0.741	4	-2.076	0.595	7
	ADF	-1.296	0.889	7	-2.024	0.589	7
	PP	-9.630	0.461	7	-8.897	0.515	7
the Philippines 73:4-96:3	WS	-1.554	0.875	11	-2.364	0.383	3
	ADF	-1.188	0.913	11	-2.437	0.360	3
	PP	-6.912	0.672	11	-11.618	0.337	3
Thailand 73:4-96:3	WS	-1.248	0.946	5	-2.163	0.531	3
	ADF	-1.857	0.677	3	-2.313	0.427	5
	PP	-7.079	0.658	3	-9.147	0.496	5
Singapore 73:4-96:3	WS	-1.153	0.959	7	-2.388	0.367	5
	ADF	-1.006	0.943	3	-2.221	0.478	5
	PP	-2.915	0.940	3	-7.246	0.644	5
Taiwan 73:4-96:3	WS	-1.921	0.700	13	-2.664	0.202	3
	ADF	-1.848	0.681	13	-3.044	0.120	3
	PP	-3.959	0.889	13	-13.419	0.248	3

Table 3 Unit Root Tests During the Post-Bretton-Woods Period (continued)

(3) WPI real exchange rates with no trend

country sample period		in the US dollar			in the Japanese yen		
		TestStat	P-value	lags	TestStat	P-value	lags
Korea	WS	-1.612	0.428	12	-1.652	0.399	3
73:4-95:12	ADF	-2.865	0.050	2	-1.375	0.594	3
	PP	-8.223	0.208	2	-3.513	0.595	3
Indonesia	WS	-1.406	0.581	4	-1.392	0.591	5
73:4-95:12	ADF	-1.448	0.559	2	-0.923	0.780	7
	PP	-3.763	0.566	2	-1.595	0.826	7
the Philippines	WS	-1.151	0.748	10	-2.819	0.020	3
73:4-95:12	ADF	-1.632	0.467	10	-2.903	0.045	3
	PP	-14.347	0.047	10	-14.227	0.048	3
Thailand	WS	-1.904	0.238	5	-1.502	0.509	3
73:4-95:12	ADF	-1.801	0.380	3	-1.320	0.620	3
	PP	-4.826	0.451	3	-3.007	0.657	3
Taiwan	WS	-2.058	0.165	10	-1.963	0.208	5
73:4-95:12	ADF	-2.376	0.149	6	-1.746	0.407	3
	PP	-12.079	0.082	6	-5.694	0.372	3
Singapore	WS	-1.107	0.772	9	-1.335	0.632	5
74:1-95:12	ADF	-1.650	0.457	9	-1.392	0.586	5
	PP	-6.389	0.318	9	-3.029	0.654	5
Malaysia	WS	-1.407	0.580	4	-1.160	0.743	3
86:1-95:12	ADF	-1.290	0.634	3	-3.279	0.016	3
	PP	-4.32687	0.50214	3	-23.167	0.005	3

(4) WPI real exchange rates with trend

country sample period		in the US dollar			in the Japanese yen		
		TestStat	P-value	lags	TestStat	P-value	lags
Korea	WS	-1.524	0.884	12	-1.956	0.678	3
73:4-95:12	ADF	-3.029	0.124	2	-2.989	0.135	3
	PP	-8.553	0.541	2	-10.504	0.403	3
Indonesia	WS	-0.782	0.986	4	-1.295	0.938	5
73:4-95:12	ADF	-3.745	0.020	2	-2.515	0.321	7
	PP	-14.538	0.202	2	-9.909	0.442	7
the Philippines	WS	-4.578	0.001	10	-2.799	0.145	3
73:4-95:12	ADF	-4.496	0.002	10	-3.342	0.060	3
	PP	-35.346	0.003	10	-17.717	0.111	3
Thailand	WS	-1.682	0.827	5	-2.290	0.436	3
73:4-95:12	ADF	-1.560	0.808	3	-2.493	0.331	3
	PP	-5.170	0.809	3	-12.029	0.315	3
Taiwan	WS	-2.269	0.452	10	-2.812	0.140	5
73:4-95:12	ADF	-2.701	0.236	6	-3.211	0.082	3
	PP	-12.952	0.269	6	-15.337	0.174	3
Singapore	WS	-2.349	0.394	3	-2.674	0.197	5
74:1-95:12	ADF	-2.419	0.370	3	-2.575	0.291	5
	PP	-10.454	0.406	3	-8.532	0.542	5
Malaysia	WS	-1.697	0.820	4	-2.341	0.399	3
86:1-95:12	ADF	-1.693	0.754	4	-3.570	0.032	3
	PP	-9.927	0.441	4	-27.953	0.014	3

Notes) 1. "WS", "ADF", and "PP" respectively denote unit root tests of Weighted Symmetric, Augumented Dickey-Fuller (tau), and Phillips-Perron (Z).
2. P-values of ADF and PP were calculated by MacKinnon (1994). P-values of WS were based on TSP v. 4.3.

Table 4 The Variances of Real Exchange Rates during the Post-Bretton Woods Period

(1) CPI real exchange rates

country sample period	type of variances	(A) variances in US dollar	(B) variances in the yen	relative values (B)/(A)
Korea	unconditional	0.00023	0.00098	4.269
73:4-96:3	conditional	0.00021	0.00088	4.212
Hong Kong	unconditional	0.00021	0.00091	4.354
73:4-96:3	conditional	0.00019	0.00079	4.210
Indonesia	unconditional	0.00099	0.00158	1.596
73:4-96:3	conditional	0.00092	0.00142	1.556
Malaysia	unconditional	0.00022	0.00076	3.412
73:4-96:3	conditional	0.00020	0.00063	3.133
the Philippines	unconditional	0.00055	0.00166	3.008
73:4-96:3	conditional	0.00054	0.00155	2.877
Thailand	unconditional	0.00018	0.00082	4.543
73:4-96:3	conditional	0.00017	0.00075	4.420
Singapore	unconditional	0.00023	0.00070	3.086
73:4-96:3	conditional	0.00019	0.00063	3.209
Taiwan	unconditional	0.00035	0.00099	2.864
73:4-96:3	conditional	0.00031	0.00089	2.832

(2) WPI real exchange rates

country sample period	type of variances	(A) variances in US dollar	(B) variances in the yen	relative values (B)/(A)
Korea	unconditional	0.00027	0.00079	2.965
73:4-95:12	conditional	0.00025	0.00074	2.933
Indonesia	unconditional	0.00080	0.00127	1.586
73:4-95:12	conditional	0.00077	0.00123	1.590
Malaysia	unconditional	0.00017	0.00062	3.737
86:8-95:12	conditional	0.00016	0.00055	3.470
the Philippines	unconditional	0.00053	0.00123	2.326
86:8-95:12	conditional	0.00051	0.00115	2.265
Thailand	unconditional	0.00025	0.00066	2.680
86:8-95:12	conditional	0.00024	0.00062	2.646
Singapore	unconditional	0.00030	0.00061	2.039
74:8-95:12	conditional	0.00026	0.00051	1.993
Taiwan	unconditional	0.00022	0.00065	2.908
73:4-95:12	conditional	0.00019	0.00059	3.041

Table 5 The Variances of the Real Exchange Rates after 1987

(1) CPI real exchange rates

country sample period	type of variances	(A) variances in US dollar	(B) variances in the yen	relative values (B)/(A)
Korea	unconditional	0.00008	0.00084	10.745
87:1-96:3	conditional	0.00006	0.00071	12.175
Hong Kong	unconditional	0.00002	0.00090	38.063
87:1-96:3	conditional	0.00002	0.00073	35.764
Indonesia	unconditional	0.00005	0.00082	17.327
87:1-96:3	conditional	0.00004	0.00069	16.947
Malaysia	unconditional	0.00013	0.00081	6.378
87:1-96:3	conditional	0.00011	0.00068	6.265
the Philippines	unconditional	0.00025	0.00136	5.465
87:1-96:3	conditional	0.00021	0.00106	5.155
Thailand	unconditional	0.00005	0.00064	12.741
87:1-96:3	conditional	0.00004	0.00054	12.152
Singapore	unconditional	0.00011	0.00063	5.694
87:1-96:3	conditional	0.00011	0.00055	5.236
Taiwan	unconditional	0.00026	0.00087	3.292
87:1-96:3	conditional	0.00023	0.00071	3.024

(2) WPI real exchange rates

country sample period	type of variances	(A) variances in US dollar	(B) variances in the yen	relative values (B)/(A)
Korea	unconditional	0.00007	0.00063	8.989
87:1-95:12	conditional	0.00006	0.00054	9.477
Indonesia	unconditional	0.00012	0.00058	4.666
87:1-95:12	conditional	0.00009	0.00049	5.283
Malaysia	unconditional	0.00017	0.00062	3.625
87:1-95:12	conditional	0.00016	0.00055	3.413
Philippines	unconditional	0.00037	0.00116	3.130
87:1-95:12	conditional	0.00032	0.00096	2.960
Thailand	unconditional	0.00010	0.00050	5.200
87:1-95:12	conditional	0.00009	0.00039	4.198
Singapore	unconditional	0.00039	0.00063	1.614
87:1-95:12	conditional	0.00034	0.00058	1.691
Taiwan	unconditional	0.00009	0.00060	6.308
87:1-95:12	conditional	0.00008	0.00050	6.049

Table 6 Unit Root Tests during the Bretton-Woods Period

(1) CPI real exchange rates with no trend

country sample period		in the US dollar			in the Japanese yen		
		TestStat	P-value	lags	TestStat	P-value	lags
Malaysia	WS	1.696	1.000	2	1.913	1.000	2
57:1-71:7	ADF	0.320	0.978	2	0.772	0.991	6
	PP	0.503	0.978	2	0.385	0.974	6
the Philippines	WS	-1.150	0.748	2	-0.699	0.920	2
57:1-71:7	ADF	-1.381	0.591	2	-1.012	0.749	2
	PP	-3.944	0.545	2	-2.069	0.772	2
Taiwan	WS	-1.693	0.370	2	-1.657	0.396	2
57:5-71:7	ADF	-1.796	0.383	2	-1.454	0.556	2
	PP	-6.613	0.302	2	-5.094	0.425	2
Singapore	WS	0.360	0.996	3	2.285	1.000	3
61:1-71:7	ADF	0.829	0.992	3	-0.497	0.893	5
	PP	0.799	0.986	3	-0.505	0.926	5

(2) CPI real exchange rates with trend

country sample period		in the US dollar			in the Japanese yen		
		TestStat	P-value	lags	TestStat	P-value	lags
Malaysia	WS	-1.460	0.902	2	-2.620	0.224	2
57:1-71:7	ADF	-1.204	0.910	2	-3.040	0.121	2
	PP	-3.881	0.893	2	-20.917	0.059	2
the Philippines	WS	-2.762	0.159	2	-2.580	0.246	2
57:1-71:7	ADF	-2.563	0.297	2	-2.428	0.365	2
	PP	-12.617	0.285	2	-10.873	0.380	2
Taiwan	WS	-2.453	0.323	2	-2.585	0.243	2
57:5-71:7	ADF	-2.225	0.476	2	-2.543	0.307	2
	PP	-11.734	0.330	2	-13.085	0.263	2
Singapore	WS	-1.143	0.960	3	-3.160	0.054	2
61:1-71:7	ADF	-1.130	0.924	3	-2.260	0.456	5
	PP	-4.207	0.874	3	-23.776	0.033	5

Table 6 Unit Root Tests During the Bretton-Woods Period (continued)

(3) WPI real exchange rates with no trend

country sample period		in the US dollar			in the Japanese yen		
		TestStat	P-value	lags	TestStat	P-value	lags
Korea	WS	-0.960	0.840	2	-1.213	0.711	2
57:1-71:7	ADF	-1.810	0.375	2	-1.749	0.406	2
	PP	-5.093	0.425	2	-5.100	0.424	2
the Philippines	WS	-1.429	0.564	2	-1.662	0.392	2
57:1-71:7	ADF	-1.444	0.561	2	-1.490	0.538	2
	PP	-5.280	0.408	2	-5.637	0.377	2
Thailand	WS	-2.580	0.040	2	-2.297	0.088	2
57:1-71:7	ADF	-2.394	0.143	2	-2.414	0.138	3
	PP	-12.763	0.069	2	-12.361	0.076	3
Taiwan	WS	-1.696	0.368	2	-1.204	0.717	2
57:5-71:7	ADF	-1.602	0.483	2	-2.065	0.259	2
	PP	-4.766	0.457	2	-6.421	0.316	2

(4) WPI real exchange rates with trend

country sample period		in the US dollar			in the Japanese yen		
		TestStat	P-value	lags	TestStat	P-value	lags
Korea	WS	-2.469	0.312	2	-2.427	0.340	2
57:1-71:7	ADF	-2.364	0.399	2	-2.225	0.476	2
	PP	-11.581	0.339	2	-10.733	0.389	2
the Philippines	WS	-2.828	0.134	2	-2.670	0.200	2
57:1-71:7	ADF	-2.684	0.243	2	-2.664	0.251	2
	PP	-15.408	0.172	2	-14.753	0.194	2
Thailand	WS	-2.700	0.186	2	-2.807	0.142	3
57:1-71:7	ADF	-2.507	0.324	2	-2.684	0.243	3
	PP	-14.637	0.198	2	-16.701	0.135	3
Taiwan	WS	-1.592	0.862	2	-1.916	0.704	2
57:5-71:7	ADF	-1.263	0.897	2	-1.868	0.671	2
	PP	-4.646	0.846	2	-8.361	0.555	2

Notes) 1. "WS", "ADF", and "PP" respectively denote unit root tests of Weighted Symmetric, Augumented Dickey-Fuller (tau), and Phillips-Perron (Z).
2. P-values of ADF and PP were calculated by MacKinnon (1994). P-values of WS were based on TSP v. 4. 3.

Table 7 The Variances of the Real Exchange Rates during the Bretton Woods Period

(1) CPI real exchange rates

country sample period	type of variances	(A) variances in US dollar	(B) variances in the yen	relative values (B)/(A)
Malaysia	unconditional	0.00005	0.00011	2.244
57:8-71:7	conditional	0.00005	0.00010	2.157
Philippines	unconditional	0.00355	0.00356	1.002
57:8-71:7	conditional	0.00350	0.00350	1.000
Taiwan	unconditional	0.00042	0.00050	1.175
57:12-71:7	conditional	0.00041	0.00049	1.180
Singapore	unconditional	0.00012	0.00017	1.426
61:8-71:7	conditional	0.00010	0.00015	1.441

(2) WPI real exchange rates

country sample period	type of variances	(A) variances in US dollar	(B) variances in the yen	relative values (B)/(A)
Korea	unconditional	0.00522	0.00527	1.010
57:8-71:7	conditional	0.00515	0.00520	1.010
Phillipines	unconditional	0.00377	0.00378	1.003
57:8-71:7	conditional	0.00371	0.00372	1.002
Thailand	unconditional	0.00064	0.00065	1.028
57:8-71:7	conditional	0.00061	0.00063	1.025
Taiwan	unconditional	0.00022	0.00022	1.011
58:5-71:7	conditional	0.00022	0.00022	1.002

Table 8 Linkage of the Relative Prices in East Asian Economies

(1) Korea CPI Sample: 1970-1994

	Food	Clothing	Housing	Transport
Japan	1.1242	0.7998	-0.2371	1.4672
	[2.354]	[2.8]	[-0.917]	[1.765]
The U.S.	-0.0043	-0.1570	-1.5376	-0.2271
	[-0.017]	[-0.59]	[-1.44]	[-0.464]
D-W	1.6438	1.7533	1.1997	0.7488
Ad-R2	0.4881	0.4956	0.1116	0.0210
Method	AR1, T	AR1, T	AR1, T	OLS, T

(2) Korea WPI Sample: 1970-1994

	P Food	Chemical	G Machinery	E Machinery	Lumber	Plastic	Textile
Japan	0.3203	0.2918	1.1504	1.1091	0.6078	0.6492	1.1337
	[1.7]	[0.895]	[2.745]	[4.304]	[3.214]	[3.266]	[3.606]
The U.S.	0.4405	-0.0859	-0.1448	-0.6548	0.1867	-0.1240	-3.4542
	[2.411]	[-0.314]	[-0.364]	[-1.513]	[0.843]	[-0.639]	[-3.58]
D-W	1.4064	1.3172	1.9429	0.9245	1.7828	1.4828	0.9180
Ad-R2	0.9467	0.8196	0.9532	0.9654	0.7652	0.4445	0.7670
Method	AR1, T	AR1	AR1, T	AR1	AR1	AR1	OLS

	Paper	Transpot	Non Metal	Iron&Steel	Motor	TV
Japan	0.3406	0.7940	0.3243	0.1616	1.6632	0.1372
	[2.266]	[2.505]	[1.662]	[0.697]	[4.122]	[0.896]
The U.S.	0.1785	0.1498	0.5151	-0.3379	-0.0993	1.1644
	[0.528]	[0.35]	[2.374]	[-1.142]	[-0.233]	[6.729]
D-W	1.0164	1.1996	1.0339	1.3040	1.1710	1.8130
Ad-R2	0.8435	0.9200	0.8642	0.9729	0.9636	0.9890
Method	AR1	AR1	AR1	AR1, T	OLS, T	AR1

Table 8 Linkage of the Relative Prices in East Asian Economies (continued)

(3) Taiwan CPI Sample: 1970–1994

	Food	Clothing	Housing
Japan	0.77738	1.21198	0.55638
	[2.204]	[4.186]	[5.069]
The U.S.	0.47627	-0.86375	-1.03809
	[2.541]	[-3.626]	[-2.461]
D-W	1.36510	1.57926	1.97880
Ad-R2	0.72808	0.97597	0.86574
Equation	OLS, T, T2	AR1, T	OLS, T, T2

(4) Taiwan WPI Sample: 1970–1994

	P Food	Chemical	G Machinery	E Machinery	Lumber	Plastic	Textile	Paper	Transport
Japan	1.0189	0.5963	1.3687	1.7863	0.4382	0.1234	1.5809	0.5273	1.1991
	[4.334]	[1.734]	[10.255]	[4.266]	[3.738]	[0.896]	[5.278]	[3.076]	[5.037]
The U.S.	0.2542	0.1415	0.2750	-0.5812	0.2767	0.8317	-2.0367	0.5302	0.4245
	[1.274]	[0.406]	[1.167]	[-1.715]	[1.962]	[6.847]	[-2.222]	[2.533]	[1.508]
D-W	1.8546	1.1689	2.0341	1.4934	1.4762	1.5283	1.4497	1.5695	0.9700
Ad-R2	0.7362	0.7787	0.8986	0.9621	0.8116	0.8852	0.8955	0.8671	0.8538
Equation	AR1, T	OLS, T	OLS, T	OLS, T	AR1	AR1, T	OLS	OLS, T, T2	OLS, T

(5) Hong Kong CPI Sample: 1970–1994

	Food	Clothing	Housing	Transport
Japan	-0.2685	-0.211381	0.3891	1.5708
	[-0.767]	[-0.649]	[1.447]	[1.016]
The U.S.	0.3909	0.743015	0.362258	1.46246
	[2.072]	[3.611]	[0.323]	[1.263]
D-W	0.9432	1.47391	1.25848	1.03
Ad-R2	0.4797	0.92244	0.7848	0.3540
Method	AR1	AR1	AR1	OLS, T, T2

(6) Malaysia CPI Sample: 1970–1993

	Food	Clothing	Transport
Japan	1.0317	0.8284	-0.1959
	[2.944]	[5.813]	[-0.599]
The U.S.	0.3496	-0.5326	0.3035
	[1.852]	[-4.272]	[0.887]
D-W	1.9085	1.8325	0.9053
Ad-R2	0.7957	0.8474	0.6239
Method	AR1, T	AR1, T	AR1

Table 8 Linkage of the Relative Prices in East Asian Economies (continued)

(7) the Philippines CPI Sample: 1970-1992

	Food	Clothing	Housing
Japan	-0.35835	0.50848	0.20198
	[-0.788]	[1.993]	[0.987]
The U.S.	0.51327	-0.40056	-0.35131
	[2.389]	[-1.505]	[-0.461]
D-W	1.63290	1.27229	1.68380
Ad-R2	0.32869	0.80266	0.84925
Method	AR1	OLS, T, T2	OLS, T, T2

(8) the Philippines WPI Sample: 1970-1992

	P Food	Chemical
Japan	0.80741	0.73906
	[2.652]	[1.352]
The U.S.	0.34854	-0.10607
	[1.065]	[-0.247]
D-W	1.74935	1.57211
Ad-R2	0.71313	0.51623
Method	AR1	AR1

(9) Indonesia CPI Sample: 1970-1992

	Food	Clothing	Housing
Japan	-5.2754	1.2371	0.4431
	[-2.151]	[1.764]	[2.51]
The U.S.	1.3144	-2.9539	-2.2194
	[1.030]	[-4.04]	[-3.148]
D-W	2.10	0.8480	1.5933
Ad-R2	0.6109	0.9267	0.3759
Method	AR1, T	OLS, T, T2	OLS, T

(10) Indonesia WPI Sample: 1970-1990

	G Machinery	E Machinery	Lumber	Non Metal	Iron&Steel
Japan	5.3193	1.2179	-0.0066	-0.4018	0.7503
	[5.442]	[7.04]	[-0.022]	[-1.352]	[0.739]
The U.S.	-4.8417	0.0862	0.3762	0.4632	0.8374
	[-1.89]	[0.132]	[0.995]	[1.564]	[0.93]
D-W	1.1000	1.1197	1.5612	1.1897	1.6578
Ad-R2	0.6910	0.7854	0.7077	0.7881	0.7142
Method	OLS, T	OLS, T	AR1	AR1	AR1

(11) Singapore CPI Sample: 1970-1993

	Food	Clothing	Housing	Transport
Japan	-0.29019	-0.08336	0.06083	1.14951
	[-0.878]	[-0.369]	[0.261]	[2.215]
The U.S.	0.51847	0.701727	1.3852	0.539954
	[2.972]	[3.489]	[1.432]	[1.161]
D-W	1.12338	1.44294	1.18186	1.9832
Ad-R2	0.82099	0.97463	0.40200	0.64674
Method	OLS, T, T2	AR1, T	AR1	AR1, T

(12) Singapore WPI Sample: 1970-1993

	P Food	Chemical	G Machinery
Japan	1.5289	-0.3749	1.6119
	[6.423]	[-0.586]	[4.87]
The U.S.	1.0874	0.9337	0.8687
	[6.558]	[1.622]	[2.423]
D-W	1.9316	1.6243	1.5449
Ad-R2	0.9176	0.7309	0.8606
Method	OLS, T	AR1, T	AR1

Table 8 Linkage of the Relative Prices in East Asian Economies (continued)

(13) Thailand CPI Sample: 1970-1993

	Food	Clothing	Housing	Transport
Japan	0.3008	0.0852	0.0449	0.1001
	[0.784]	[0.596]	[0.285]	[0.205]
The U.S.	0.1887	-0.3360	0.4092	0.9275
	[0.889]	[-2.252]	[0.629]	[1.798]
D-W	1.5140	1.2266	0.5707	1.7453
Ad-R2	0.7367	0.8696	0.7290	0.7870
Method	AR1, T	OLS, T, T2	AR1	AR1

(14) Thailand WPI Sample: 1970-1993

	P Food	Chemical	G Machinery	Textile	Paper	Transport
Japan	0.2585	0.0660	0.7937	1.1124	0.0894	1.1516
	[2.1]	[0.103]	[3.302]	[3.072]	[0.623]	[3.981]
The U.S.	0.1866	0.5314	0.1954	-1.5090	0.3086	-0.5720
	[1.371]	[0.983]	[0.798]	[-1.357]	[1.631]	[-1.77]
D-W	1.7872	1.3135	1.4483	1.5933	1.6755	1.7666
Ad-R2	0.3788	0.6222	0.7861	0.7481	0.6385	0.7251
Method	AR1	AR1	AR1	OLS	AR1	AR1, T

Notes of Table 8)

1. t-values are in parentheses.
2. "OLS" indicates that the estimation method was the ordinary square method.
3. "AR1" indicates that the first-order serial correlation was corrected by the ML method.
4. "T" indiates that a time trend term was included in the regression.
5. "T2" indicates that a square time trend was included in the regression.
6. "P Food" = processed food, "G Machinery" = general machinery, and "E Machinery" = electric machinery.

Table 9 Linkage of the Relative Prices in Canada

	Food	Textile	Wood	Paper	Non-metal	Basic Metal
Japan	0.1661	-0.060413	0.0633	0.1679	-0.0019	0.4377
	[3.2]	[-1.325]	[0.970]	[1.520]	[-0.020]	[3.683]
The U.S.	0.2556	0.163314	0.94743	0.251677	0.2676	0.67166
	[11.984]	[3.464]	[21.678]	[1.558]	[3.809]	[6.8885]
D-W	1.8713	1.65384	1.39577	1.96605	1.7506	1.3727
Ad-R2	0.9761	0.986009	0.6989	0.0129	0.1170	0.9831
method	AR1	AR1, T	AR1, T	AR1, T	AR1, T	AR1, T

Notes)
1. t-values are in parentheses.
2. "AR1" indicates that the first-order serial correlation was corrected by the ML method.
3. "T" indiates that a time trend term was included in the regression.