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The J-Curve: Evidence from East Asia

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Abstract

This paper examines the determinants of trade balances of seven East Asian countries, using cointegration technique, error correction model, and impulse response function. Among other things, our investigation confirms the existence of J-curve effect and the results show that there are significant differences in the duration and the extent of the J-curve effect across countries. Several explanations consistent with those findings are advanced in the paper, including differences in exchange rate and trade regimes across sample countries. It is likely that liberalization of an exchange rate regime coupled with liberalization of trade may act to dampen the J-curve effect.

• **JEL Classifications:** F1, O1

• **Key Words:** trade, economic development

I. Introduction

Until the mid-1997 financial crisis, the East Asian countries' economic performance had been nothing short of exemplary.[1] The growth rates among countries in the region that averaged from 6 to 8 percent annually for more than a

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[1]For example, Korea experienced an almost tenfold increase in its per capita income between 1965 and 1995, while Thailand saw a fivefold rise and Malaysia a fourfold rise in its per capita income (IMF, 1997, pp 77).

decade, suddenly turned negative. Furthermore, the foreign exchange and equity markets in East Asia declined sharply in the second half of 1997 (Goldstein, 1998). The East Asian economies, which enjoyed almost continuing high employment and even intermittent labor shortage, now experienced rapidly rising unemployment.

The foreign exchange and equity market crisis in East Asia provides yet another illustration of financial instability that has occurred with increasing frequency since the advent of flexible exchange rates in the early 1970s. This was evidenced by the banking and debt crisis in South America, the Latin American debt crisis of the 1980s, and the U.S. Savings and Loan exigency of the late 1980s. The European monetary system crisis of 1992 was followed by the Mexican peso crisis of 1994, culminating in the more recent East Asian crisis of 1997 (UNCTAD, 1998).

An IMF report (1997) noted that 116 currency misalignments and currency "crashes" (defined as depreciations of at least 25 percent) occurred between 1975 and 1996. While each currency crisis is unique in terms of its origins and severity, many contain certain common elements. First, many of the currency crises were preceded by liberalization of the economy in general and the financial sector in particular. Second, in many instances there was a moral hazard problem of bailing out large uninsured creditors of large banks. Third, episodes of currency instability were associated with sharp increase in capital inflows, which were subsequently followed by large capital outflows.

In the 1980s and 1990s there was a marked shift toward greater exchange rate flexibility among many developing countries. In Asia, most countries adopted some form of a managed float, although in the 1990s a number of them have chosen to "independently" float their exchange rates (IMF, 1997). Developing countries with unstable domestic macroeconomic conditions often were unable to maintain fixed exchange rates and had to resort to a variant of a flexible exchange rate regime. In Asia, as in a number of other developing countries, exchange rate flexibility was increasingly used as an instrument of external adjustment in view of their growing global economic and financial interdependence. In the two years prior to the Asian currency crisis of June 1997, countries that pegged their currencies (mostly informally) to the U.S. dollar experienced varying degrees of appreciation of their real effective exchange rates (Goldstein, 1998). Furthermore, the appreciation of their currencies coincided with large and growing current account deficits, which worsened their macro economic imbalances.

Widespread interest in the causes and effects of East Asian crisis, among researchers and practi-tioners alike, resulted in the publication of a number of papers that analyzed its causes and suggested possible reforms. Since a number of East Asian countries have seen their currencies depreciate sharply in 1997, an important question is whether changes in East Asian countries real effective exchange rate have had an impact on their trade balances. While theoretical work in international macroe-conomics points to a predictable relationship between the exchange rate and trade balance, earlier empirical work provided conflicting views about this relationship. Those earlier empirical studies have examined the relationship between exchange rate changes and the trade balance, and more specifically the reasons behind the trade deficits. For the U.S., Bryant and Holtman (1987), and Krugman and Bald-win (1987) suggested that the rise in the value of the dollar was responsible for U.S. trade deficits in the 1980s. This view of the relationship between the exchange rate and trade deficits has been challenged by, among others, Mundell (1987). In his model the trade balance is related to differences in the country's saving and investment. The latter approach questions the relevance of exchange rates in determining the trade balance of a country. On the other hand, Feldstein (1987) and Hutchinson and Piggot (1984) have suggested that the primary reason for the worsening of the U.S. trade balance were the growing U.S. budget deficits. Rose and Yellen (1989) and Rose (1990) have shown that the short run relation-ship between the exchange rate and the trade balance does not hold for neither the G-7 countries nor for a group of developing countries.

On the other hand, Backus (1993), using a vector auto-regressive model, confirmed the existence of a short run relationship between the real exchange rate and real trade balance for Japan. Using the same model, Demirden and Pastine (1995) also found that a short-term relationship exists between exchange rates and the U.S. trade balance. Bahmani-Oskooee and Asle (1994) examined the relationship between the ratio of imports to exports and the real effective exchange rate for several countries using the vector error correction model. They found evidence of a short-term relationship but little or no evidence of a long-term relationship between real effective exchange rates and the trade balance.

Such conflicting results on the relationship between exchange rate and the trade balance point to the need for further research in this area. Some of the earlier studies have been criticized because several variables in the trade balance model exhibited non-stationarity. As a result, parameter estimates from ordinary least square regressions were invalid because in this case, the null hypothesis can be wrongly rejected (Engel and Granger, 1987).

In this paper we examine the relationship between the trade balances and effective real exchange rates of seven East Asian countries: Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, and Thailand. In what follows, we first examine the stationarity of the data for each of the variables for the countries in our sample. Subsequently, we analyze the long-term relationship between the exchange rate and the trade balance and also the short-term exchange rate dynamics. The plan of the paper is as follows: Section II outlines the theory behind the relationship between exchange rate and the trade balance; Section III describes the model used in this study; Section IV discusses the results obtained from estimating the trade balance model; and Section V summarizes the main results of the paper and offers certain policy implications.

II. Theoretical Aspects of the Relationship between Exchange Rate and the Trade Balance

Changes in the real effective exchange rate may have different effects on the components of the trade balance, in both the short-run and the long-run. In equation (1) below, the trade balance (TB_t) is defined as the value of exports ($Qx_t \cdot Px_t$) minus the value of imports ($Qm_t \cdot Pm_t$).

$$TB_t = Qx_t \cdot Px_t - Qm_t . Pm_t \tag{1}$$

Where:

Qx_t is the volume of exports in time period t;

Px_t is the price of exports in domestic currency in time period t;

Qm_t is the volume of imports in time period t;

Pm_t is the price of imports in domestic currency in time period t.

A depreciation or a devaluation[2] of a country's currency can result in a decline in the value of a country's currency vis-à-vis other currencies. This makes exports relatively cheaper in foreign currency units while imports become relatively more expensive in terms of domestic currency units. A decrease in the price of exports will cause an increase in quantity demanded of exports while an increase in the

[2]Devaluation refers to an official lowering of the value of a countrys currency vis-à-vis other currencies and depreciation refers to decline in the value of a countrys currency vis-à-vis other currencies due to market forces. However, in this paper we use these terms interchangeably.

price of imports will result in a decrease in the quantity demanded of imports. If certain restrictions on demand and supply of imports and exports are met[3], a depreciation of a currency will lead to an increase in the value of exports and a decrease in the value of imports. Thus, over time a depreciation of a country's currency can be expected to result in an improvement in its trade balance.

However, the impact of changes in a country's exchange rate on different components of its trade balance are neither immediate nor simultaneous. Each major component of the trade balance may follow a different path of adjustment, depending on the structure of trade and how economic agents respond to price changes. For example, a large volume of international trade may be conducted in terms of future contracts which may fix the price of traded goods (either in terms of the domestic or foreign currency) in the short-run, while effecting the volume of internationally traded goods in the longer run.

Apart from the scope and duration of the foreign trade contracts, economic agents may also respond with variable lags to changes in prices. For example, Junz and Rhomberg (1973) have identified at least five possible lags in the adjustment of export and import volumes to changes in their respective prices: lags in *recognition* of the changed situation, lags in the *decision* to respond to changes in the real variables, lags in *delivery*, lags in the *replacement* of inventories and materials, and lags in *production*. Thus while prices of traded goods (exports and imports) may respond relatively rapidly to the depreciation of the domestic currency, export and import volumes may take much longer to adjust to changes in export and import prices. Furthermore, if there are delays in the response of the prices of traded goods following a depreciation of the currency then the quantity of exports and imports may take even longer to adjust to the new exchange rate level. However, with the passage of time, both import and export volumes should be more responsive to changes in their relative prices and, therefore, the country's trade balance is expected to improve.

Thus, following the depreciation of a country's currency, its trade deficit can be expected to widen in the short-run (following changes in prices of exports and imports) before it improves due to the longer run response in the volume of

[3]If the supply curves for exports and imports are perfectly elastic and the Marshall-Lerner condition holds, namely that the sum of the absolute value of the price elasticities of exports and imports is greater than one, then an increase in the value of exports and a decrease in the value of imports is expected to take place. If supply curves for exports and imports are not perfectly elastic, then the Bickerdicke-Robinson-Metzler condition for a devaluation to improve the trade balance must be satisfied rather than the well known Marshall-Lerner condition (Caves *et al*., 1996, pp 367).

exports and imports. The time path of adjustment of the trade balance following a depreciation of a currency may resemble the letter "J", since in the short-run, the depreciation of the domestic currency may lead to worsening of the trade deficit (Krugman and Obstfeld, 2000).

In the long-run, export and import volumes are expected to respond to changes in export and import prices. Completion of all the adjustments on both the production and consumption side is expected to increase the responsiveness of export and import volumes to changes in their relative prices and this may increase the value of the price elasticities of imports and exports. In the long-run, we expect the Marshall-Lerner or the Bickerdicke-Robinson-Metzler condition to be satisfied and hence the depreciation of the domestic country's currency will lead to an improvement in the country's trade balance. If, on the other hand, the Marshall-Lerner or Bickerdicke-Robinson-Metzler condition are not satisfied even in the long-run, perverse changes in the trade balance due to changes in the exchange rate may persist overtime.

III. Specification of the Empirical Model

To estimate an empirical model of the trade balance, we postulate that a country's trade balance depends on both relative prices and real variables. Following Bahmani-Oskooee and Alse (1994), we define the trade balance as the ratio of imports to exports. This makes the trade balance insensitive to units of measurement and also allows for a logarithmic transformation.[4] We hypothesize that a country's trade balance depends on its real effective exchange rate, the country's aggregate income, and the weighted aggregate income of the country's most important trading partners. Specifically,

$$ln(M/X)_{jt} = \beta_0 + \Sigma\beta_1 ln(REER)_{jt} + \Sigma\beta_2 ln(WGDP)_{jt} + \Sigma\beta_3 ln(GDPC)_{jt} + \mu_{jt} \quad (2)$$

where;

$ln(M/X)_{jt}$ = Log of the ratio of imports to exports of country j at time t.

$ln(REER)_{jt}$ = Log of real effective exchange rate of country j at time t. The real effective exchange rate was calculated as $\Sigma\theta_{js1995}(E_{jst}/P_{jt})/(1/P_{st})$

[4]Since the trade balance, defined as the difference between value of exports and imports, is often in deficit and is indicated as a negative number. Since log transformation of negative numbers is not possible, defining the trade balance as a ratio makes the trade balance amenable to log transformation.

where θ_{js1995} is the share of country *j*'s exports to country s in country *j*'s total exports to its 15 largest exporting partners in 1995; E_{jst} is the bilateral nominal exchange rate of country *j* with its exporting partner *s* at time *t*; and P_{jt} and P_{st} are the wholesale price index numbers (1995 =100) of country *j* and country *j*'s exporting partner *s* respectively at time *t*.

$ln(WGDP)_{jt}$ = Log of weighted GDP of the largest 15 exporting partners of country *j* at time period *t*, at 1995 exchange rate. This series was calculated as $ln(WGDP)_{jt} = \Sigma\theta_{js1995}GDP_{st}$, where θ_{js1995} is the share of country *j*'s exports to country *s* in country *j*'s total exports to 15 largest exporting partner countries in 1995. GDP_{st} is the GDP of country s at time *t*.

$ln(GDPC)_{jt}$ = Log of GDP of country *j* at time *t*, at 1995 exchange rate.

μ_{jt} = error term for country *j* at time *t*.

The data used in this study were obtained from the International Monetary Fund's *International Financial Statistics* (IFS), CD-ROM, September 1999. The data for export shares for each of the countries' top 15 trading partners were obtained from International Monetary Funds *Direction of Trade Statistics Yearbook,* 1995.

To define the relevant set of economic variables that determine the ratio of imports to exports of a certain country involves four major steps. *First*, we test whether each of the variables is non stationary in levels (i.e., has unit roots). In each case, where a variable has unit roots first differencing makes them stationary. The common practice recommended by Engel and Granger (1987) is to use the Augmented Dickey-Fuller (ADF) test for unit roots. The cumulative distribution of the ADF test statistic is given in Mackinnon (1991).

Second, the Johansen procedure is used by applying maximum likelihood to an autoregressive representation of the form given in equation (3) below:

$$\Delta Z_t = \mu_t + \Sigma_j \gamma_j \Delta Z_{t-j} + \Pi X_{t-j} + v_t \quad (3)$$

where Z is the vector of endogenous variables (M/X, REER, etc.); μ_t is the deterministic component; γ_j is a matrix of coefficients; $\Pi = \alpha\beta'$, where α is the parameter for speed of adjustment and β' is the cointegrating vector, and v_t is the residual matrix. The long-term co-movement between a set of time series variables can be detected by cointegration techniques suggested by Engel and

Granger (1987) or by a more powerful test developed by Johansen and Juselius (1990) in the context of a vector error correction model.

The cointegration test focuses on the properties of the matrix coefficient Π. Hence, in the trade balance model for determining the ratio of imports to exports, the rank of Π could be between zero if no cointegrating vector exists, and n, the number of variables in the system. The basic idea behind cointegration is that two or more variables can be regarded as defining a long-run relationship even though they may drift apart in the short-run. This long-run relationship is known as the cointegrating vector. Because there is a long-run relationship between variables, a regression containing levels of all variables of a cointegrating vector will have a stationary error term, even though each one of the variables taken alone is non-stationary. Before estimating the cointegrating parameters, the order of integration of each series will be examined.

The Granger representation theorem states that if a cointegrating relationship exists, then a dynamic error correction representation of the data will exist as well. *Third*, we estimate an error correction model (Engel and Granger, 1987) with all non-stationary variables in the cointegration equation (3):

$$\Delta ln(M/X)_{jt} = \alpha_j + \Sigma\beta_{ji}\Delta ln(\mathrm{M/X})_{jt-i} + \Sigma\beta_{ji}\Delta ln(REER)_{jt-i} + \Sigma\zeta_{ji}\Delta ln(WGDP)_{jt-i} + \Sigma\eta_{ji}\Delta ln(GDPC)_{jt-i} + \lambda_j\mu_{jt-1} + w_{jt} \quad (4)$$

where all the variables were defined above. The disturbance term is w_{jt}; Δ represents the first difference operator; μ_{jt-1} is the error correction (one lagged error) generated from Johansen multivariate procedure (Sedgley and Smith, 1996); and Σ represents sum of different lagged values for each of the regressors. Thus, equation (4) represents the short and long run relationships between the trade balance and a set of independent variables. The long-run relationship is captured by the lagged value of the long-run disturbance term μ_{jt-1}. If that term is omitted, all variables would be in first difference, and only short-run effects could be detected (Harvey, 1991). The error correction factor plays a crucial role in the model. The coefficient of the lagged error correction gactor is an adjustment coefficient that represents the proportion by which long-term disequilibrium in the dependent variable is corrected in each short time period (Harvey, 1991; Mehra, 1993). The test of differencing explanatory variables represents the short-term causal effect whereas the long-term causal relation is implied through the significance of the t-test of the lagged error correction term.

Fourth, an impulse response function is estimated to capture the dynamic properties of the system by tracing the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables. In this study, we use the impulse response function to examine the J-curve effect by tracing the effect of one standard deviation shock in real effective exchange rate on the current and future values of the import to export ratio for each of the East Asian countries in our sample.

IV. Empirical Results

In what follows, the short and long-run interactions within a system consisting of the log of the ratio of imports to exports ($ln(M/X)_t$), the log of real effective exchange rate ($ln(REER)_t$), log of weighted GDP of the 15 largest exporting partner countries ($ln(WGDP)_t$), and the log of the country's own GDP ($ln(GDPC)_t$), are examined for each one of the countries in our sample. The quarterly data used in this study cover the period from 1980Q1 to 1998Q4.

Table 1. Unit Roots and Mean Stationary Test Results

Variable	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Thailand
A. Without Trend							
ln(M/X)	–1.65	–2.18	–1.15	–1.65	–1.14	–1.12	–0.96
Δln(M/X)	–5.28*	–5.58*	–7.21*	–5.18*	–4.52*	–5.58*	–5.14*
ln(REER)	–2.16	–1.39	–1.17	–0.64	–2.29	–1.28	–2.23
Δln(REER)	–6.42*	–4.01*	–4.24*	–4.33*	–4.76*	–3.55*	–6.27*
ln(WGDP)	–1.29	–1.61	–1.36	–1.46	–1.61	–1.55	–1.36
Δln(WGDP)	–8.07*	–10.86*	–8.44*	–8.39*	–8.57*	–8.65*	–8.23*
ln(GDPC)	–0.39	–1.35	–1.24	–1.11	–1.58	–0.11	–0.96
Δln(GDPC)	–5.73*	–5.71*	–5.09*	–4.13*	–4.84*	–7.64*	–3.35**
B. With Trend							
ln(M/X)	–2.20	–2.02	–1.70	–1.29	–0.83	–1.87	–1.69
Δln(M/X)	–5.43*	–5.67*	–7.23*	–5.18*	–4.68*	–5.68*	–5.19*
ln(REER)	–1.85	–1.83	–0.83	–2.15	–2.27	–1.39	–1.85
Δln(REER)	–6.34*	–3.92**	–4.28*	–4.37*	–4.72*	–3.55**	–6.29*
ln(WGDP)	–1.74	–2.33	–1.79	–1.65	–1.64	–1.58	–1.70
Δln(WGDP)	–8.18*	–11.63*	–8.64*	–8.66*	–8.96*	–9.03*	–8.41*
ln(GDPC)	–1.54	–1.94	–0.98	–1.64	–0.60	–1.66	–1.10
Δln(GDPC)	–5.71*	–8.04*	–5.19*	–4.13*	–4.85*	–7.59*	–3.42*

Note: 1. The null hypothesis in the *ADF* test is that the time series contains a unit root (that is, it is non stationary) against the alternative hypothesis of mean stationarity. The hypothesis is rejected if the value of the test statistic is greater than the critical value calculated by Mackinnon (1991).
2. *Significant at 1% level.
**Significant at 5% level.

Table 2a. Johansen Multivariate Cointegration Trace Test Results

Country	Trace Statistics	5% Critical Value	1% Critical Value	Null Hypothesis	Alternative Hypothesis
Indonesia	72.07*	62.99	70.05	r = 0	r ≥ 1
	44.17**	42.44	48.45	r ≤ 1	r = 2
	21.55	25.32	30.45	r ≤ 2	r = 3
	6.65	12.25	16.26	r ≤ 3	r = 4
Japan	56.81**	47.21	54.46	r = 0	r ≥ 1
	25.88	29.68	35.65	r ≤ 1	r = 2
	11.75	15.41	20.04	r ≤ 2	r = 3
	1.77	3.76	6.65	r ≤ 3	r = 4
Korea	61.66*	39.89	45.58	r = 0	r ≥ 1
	36.08*	24.31	29.75	r ≤ 1	r = 2
	17.61**	12.53	16.31	r ≤ 2	r = 3
	6.36**	3.84	6.51	r ≤ 3	r = 4
Malaysia	52.94*	39.89	45.58	r = 0	r ≥ 1
	26.22**	24.31	29.75	r ≤ 1	r = 2
	5.02	12.53	16.31	r ≤ 2	r = 3
	3.80	3.84	6.51	r ≤ 3	r = 4
Philippines	74.61*	54.64	61.24	r = 0	r ≥ 1
	33.85	34.55	40.49	r ≤ 1	r = 2
	6.64	18.17	23.46	r ≤ 2	r = 3
	3.01	3.74	6.40	r ≤ 3	r = 4
Singapore	74.12**	68.52	76.07	r = 0	r ≥ 1
	43.67	47.21	54.46	r ≤ 1	r = 2
	23.40	29.68	35.65	r ≤ 2	r = 3
	8.52	15.41	20.04	r ≤ 3	r = 4
	0.26	3.76	6.65	r ≤ 4	r = 5
Thailand	39.96**	39.89	45.58	r = 0	r ≥ 1
	18.91	24.31	29.75	r ≤ 1	r = 2
	8.66	12.53	16.31	r ≤ 2	r = 3
	1.30	3.84	6.51	r ≤ 3	r = 4

Note: 1. *r* is the number of cointegrating vectors.
2. *Significant at 1% level.
**Significant at 5% level.

Test results for unit roots and mean stationarity tests for the East Asian countries in our sample are reported in Table 1. The null hypothesis of the ADF test is that the series is non-stationary. As is evident from the ADF test results, the series $ln(M/X)_t$, $ln(REER)_t$, $ln(WGDP)_t$, and $ln(GDPC)_t$ are non-stationary in levels, but stationary in first differences. Our empirical results indicate that all variables are integrated of order one $I(1)$ and this satisfies the condition that all variables must

Table 2b. Johansen Multivariate Cointegration Equation Normalized Parameter Estimates

Country	Ln(M/X)	Ln(REER)	Ln(WGDP)	Ln(GDPC)	Ln(PINW)	Trend	Constant
Indonesia	1.00	–0.43	–1.49	–0.72		0.04	29.89
		(0.32)	(0.51)	(0.25)		(0.01)	
Japan	1.00	–3.92	0.10	–1.15		28.94	
		(1.64)	(0.52)	(0.60)			
Korea	1.00	–5.47	4.59	–2.49			
		(10.58)	(9.48)	(5.39)			
Malaysia	1.00	–0.13	0.04	–0.09			
		(0.18)	(0.02)	(0.06)			
Philippines	1.00	–0.64	0.63	–1.07		0.01	1.37
		(0.27)	(0.59)	(0.19)			
Singapore	1.00	–0.78	1.22	–0.40	1.43		–15.87
		(0.28)	(0.26)	(0.11)	(0.42)		
Thailand	1.00	–1.11	0.63	0.19(			
		(1.45)	(0.12)	0.25)			

Note: 1. Number in parantheses are asymptotic standard errors.

2. All vectors are normalized with respect to ln(M/X) by setting its coefficient equal to1. This enables a straightforward reading of different elasticities.

3. The parameters were estimated on the basis of first difference and 6 lags for each of the countries.

4. (a) For Korea, Malaysia, and Thailand, the results are based on no deterministic trend in the data.

(b) For Indonesia, Japan, and Singapore, the results are based on linear deterministic trend in the data.

(c) For Philippines, the results are based on quadratic deterministic trend in the data.

5. For Singapore an additional variable ln (PINW) or log of wholesale price index is included in estimation.

have the same order of integration to be cointegrated.

The Johansen-Juselius multivariate likelihood ratio test was used to analyze the cointegrating relationship among variables. As seen in Table 2a, the null hypothesis of zero cointegration (H_0: $r = 0$) is rejected for all the countries in our sample. Furthermore, from Table 2a it is evident that for Japan, Philippines, Singapore, and Thailand there exist no more than a single cointegrating vector, which implies the existence of a unique relationship among sets of variables. However, for Indonesia, Korea, and Malaysia the results show the existence of more than one cointegrating vector. The existence of more than one cointegrating vector may result if different structural factors dominate the relationship among variables and hence no unique relationship may be found among sets of variables. In such a case, when more than one cointegrating vector exists, the choice of one vector over another should be determined based on prior expectations about the signs of the coefficients (King *et al.*, 1991). In Table 2b, we report one cointegrating vector corresponding to the dominant relationship in which all variables carry the expected signs.

Furthermore, all vectors were normalized with respect to $\ln(M/X)_t$ by setting their coefficient equal to one for each of the countries in our sample. This allows for a straightforward interpretation of coefficient estimates, namely that they represent the relevant elasticities. The long-run elasticity of the import to export ratio with respect to the real effective exchange rate is negative, indicating that a depreciation of the real effective exchange rate will lead to a reduction in the ratio of imports to exports or an improvement in the trade balance in the long-run. Our estimates indicate that the import to export ratio is elastic with respect to changes in the real effective exchange rates (i.e., the absolute value of elasticity is greater than one), in the case of Japan, Korea, and Thailand and inelastic (i.e., the absolute value of elasticity is less than one) for Indonesia, Malaysia, Philippines, and Singapore.

There exists an ambiguity about the direction of the relationship between the trade balance and the GDP of a country's 15 largest exporting partners and the GDP of the country itself. For example, increase in the GDP of a country could result in an increase in the supply of all goods including exportable goods from that country. On the other hand, an increase in a country's real GDP or real income could lead to an increase the domestic demand for all goods including exportables and importables. Whether the demand side factors dominate the supply side factors, or vice-versa is an empirical question.

The results in Table 2b indicate that an increase in GDP of the 15 largest exporting partners led to a decrease in the ratio of imports to exports in the case of Indonesia, while an increase in the GDP of the 15 largest exporting partners have led to an increase in the ratio of imports to exports in the case of Japan, Korea, Malaysia, Philippines, Singapore, and Thailand. The ratio of imports to exports is positively related to Thailand's GDP and negatively related to the GDPs of Indonesia, Japan, Korea, Malaysia, Philippines, and Singapore.

Having established that the import to export ratio, the real effective exchange rate, GDP of a country's exporting partners, and the country's own GDP are cointegrated, we next set out to examine the short-run dynamic interactions between these variables using the error correction model.

Our empirical results suggest that the statistical fit of the model to the data is satisfactory as indicated by R^2, Adjusted R^2, Akaike's Information Criteria (AIC), and the Schwarz statistic. The coefficients of different variables indicate the existence of a short-run relationship between the import to export ratio and other

Table 3. Error Correction Model Estimates

	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Thailand
α_j	0.13 (2.71)	–0.04 (–2.30)			–0.05 (–1.17)	–0.01 (–0.90)	
Trend					0.001 (0.71)		
$\Sigma\beta_{ji}\Delta ln(M/X)_{jt-i}$	1.71	–1.51	–0.73	1.28	1.17	0.51	–0.49
$\Sigma\delta_{ji}\Delta ln(REER)_{jt-i}$	–1.40	0.08	–2.79	–1.60	–1.72	–1.14	–2.21
$\Sigma\zeta_{ji}\Delta ln(WGDP)_{jt-i}$	–2.77	2.09	–1.93	0.54	2.53	0.42	–0.99
$\Sigma\eta_{ji}\Delta ln(GDPC)_{jt-i}$	–3.49	–0.32	0.22	–0.76	–1.51	–0.09	0.26
$\Sigma\sigma_{ji}\Delta ln(PINW)_{jt-i}$						+0.65	
μ_{jt}	–0.78 (–4.43)	+0.13 (4.23)	–0.01 (–0.67)	–0.19 (–1.83)	–0.16 (–1.42)	–0.22 (–1.24)	–0.04 (–0.65)
R^2	0.59	0.82	0.74	0.58	0.43	0.56	0.55
$Adj\ R^2$	0.36	0.71	0.60	0.35	0.16	0.19	0.31
AIC	–1.56	–3.74	–2.24	–2.71	–1.76	–3.57	–2.18
Schwarz	–0.72	–2.90	–1.43	–1.90	–1.01	–2.53	–1.37

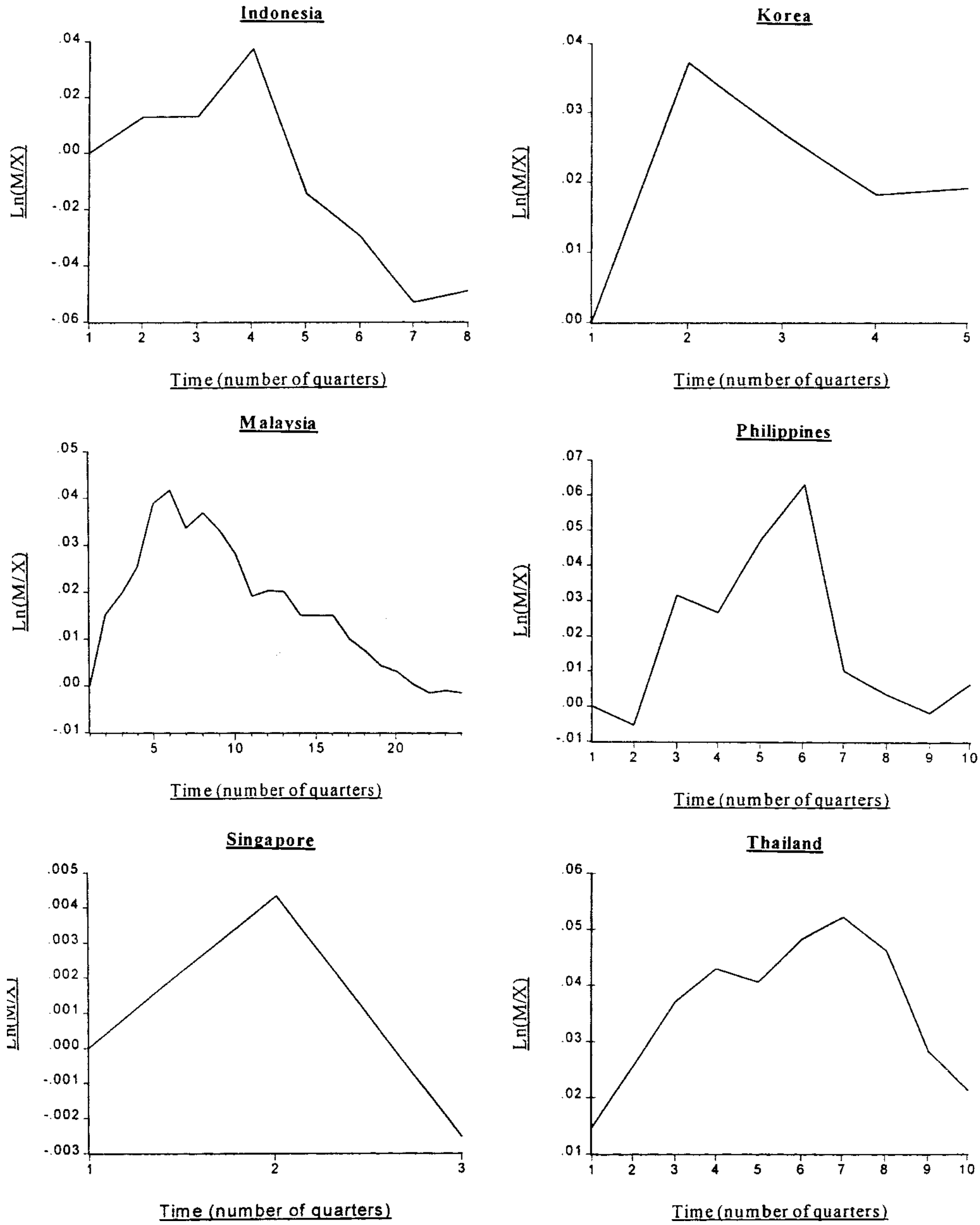
Note: 1. Figures in parentheses indicate t-values.
2. The parameters were estimated on the basis of first difference and 6 lags for each of the countries.
3. (a) For Korea, Malaysia, and Thailand, the results are based on no deterministic trend in the data.
(b) For Indonesia, Japan, and Singapore, the results are based on linear deterministic trend in the data.
(c) For Philippines, the results are based on quadratic deterministic trend in the data.
4. For Singapore an additional variable ln (PINW) or log of wholesale price index is included in estimation.

variables in the system. For the error correction model, a negative coefficient (λ) implies that the series is non explosive and that a long-run equilibrium exists. The error correction model estimates show a negative sign for each of the countries in our sample, except Japan.[5] The magnitude of λ measures the single period response of the dependent variable to deviation from equilibrium. For example, in the case of Indonesia $\lambda = -0.78$ implies that 78 percent of any quarter's deviation in the actual import to export ratio is incorporated into the next quarters change in the import to export ratio. In the case of Malaysia $\lambda = -0.19$, so that only 19 percent of any quarters deviation in the actual import to export ratio is incorporated into the next quarter's change of the import to export ratio.

Next, we considered the response of the import to export ratio to an impulse (innovation) in the real effective exchange rate. The graph of the impulse response

[5]The positive sign of ë signifies that the series is explosive, as in the case of Japan, implying that long-run equilibrium cannot be attained. Hence, Japan was dropped from any further analysis.

Graph 1. Effect of One Standard Deviation Innovation in Ln(RFER) on Ln (M/X)



functions for the countries in our sample (Graph 1) indicates that a depreciation of a country's currency leads to an initial rise in the ratio of imports to exports followed by a decline, implying an initial worsening of the trade balance, subsequently followed by an improvement in the country's trade balance. Thus, the J-curve pattern of the trade balances has been confirmed for six out of seven countries in our sample.

Furthermore, these graphs reveal differences in the duration of the J-curve effect (i.e., length of time period before trade balance improves) and differences in the extent of the J-curve effect (i.e., overall change in the trade balance). For example, the trade balance seems to improve after two quarters in the case of Korea and Singapore, it appears to improve after four quarters in the case of Indonesia, five quarters in the case of Malaysia, six quarters in the case of Philippines, and seven quarters in the case of Thailand. The graphs also reveal that the overall improvement in the trade balance was substantial in Indonesia and the overall deterioration was more substantial in the case of Malaysia, Philippines, and Thailand.[6] These results are not surprising given that the J-curve represents a stylized way of depicting the evolution of trade balances following a devaluation of the domestic currency.

Apart from the reasons mentioned in Section II, the variance across countries in the duration and the extent of the J-curve effect can also be explained in terms of differences in their commercial policies (both exchange rate and trade policies). Differences in exchange rate regimes may account for some of the differential responses of trade balance (duration and extent) to changes in exchange rate. For example, under a fixed exchange rate system, the price of tradables may adjust more sluggishly than under a market determined exchange rate system. During the sample period, exchange rate regimes varied greatly across the countries in our sample and each country changed its exchange rate regime at different points in time.[7] Also, the response of a country's trade balance to changes in exchange rate may depend on whether the country in question follows a relatively liberal or restrictive trade policy. A restrictive trade system (for example, a quota regime) can prolong the time period and the extent to which the trade balance may deteriorate initially following a currency depreciation. As with the choice of an exchange rate regime during the sample period, the extent and type of import restrictions (and to a lesser extent restrictions on exports) varied substantially across countries, with Singa-

[6]We are grateful to a referee of this journal for pointing this out.

[7]For example, the Korean Won was pegged (adjustable peg) to a basket of currencies dominated by the US dollar before 1990. In 1990 the Korean government moved towards a more market - oriented system. Since the 1980s the value of the Malaysian Ringgit has been market determined. In Indonesia, the Rupiah has been subject to a market float since 1978 and the Indonesian government has sustained real devaluation of currency at a rate about equal to the inflation rate differential between Indonesia and its trading partners. The Philippine government made various adjustments to its nominal currency with a view to maintain international competitiveness. Thailand's Baht was loosely tied to the U.S. dollar prior to 1984 and only in 1984, as a part to take a more flexible exchange rate policy, Baht was devalued by about 14 percent against the US. See Dean *et al.* (1994) for further details.

pore and Korea following a more liberal trade regime while Philippines and Thailand followed more restrictive trade policies.[8]

The above results show that the differential responses of trade balances (duration and extent) to changes in exchange rate & (Graph 1) broadly correspond to the available evidence about the nature of commercial policies (trade and exchange rate policies) pursued by the countries in our sample period. Further-more, if a devaluation is undertaken from a position of disequilibrium that may have lasted several years (such as the serious currency misalignment and large trade deficits that persisted in most East Asian countries prior to 1997), then the devaluation is more likely to prolong and accentuate an initial deterioration of the trade balance (note that the Marshall-Lerner or Bickerdicke-Robinson-Metzler condition is derived on the assumption that the country's trade balance is indeed in balance).

V. Summary and Conclusion

In this paper we have examined the short and long run relationship between the trade balance and changes in real effective exchange rates of seven East Asian countries. The reported results are consistent with the earlier work of Bryant and Holtman (1987), and Krugman and Baldwin (1987), that found that real effective exchange rate changes have a significant impact on a country's trade balance. Specifically, our empirical results lead to the following conclusions. *First*, there exists a long-run relationship between the imports to exports ratio and the real effective exchange rate, the GDP of the countries' 15 largest exporting partners, and the East Asian countries own GDP as evidenced by cointegration tests. *Second*, short-run dynamics based on the error correction model imply that this approach can play a significant role in modeling the trade balances of the East Asian countries. *Third*, the diagrams based on our estimates of the impulse response function for each of the East Asian countries, with the exception of Japan, confirmed the existence of the J-curve phenomenon. This graph also highlights the differences in the speed and extent of adjustment of export and import volumes of the East Asian countries to

[8]Dean *et al.* (1994) have shown that Singapore had been committed to a policy of free trade since the 1980s, Korea removed most of its quantitative restrictions and brought down tariff levels comparable to developed countries by 1985, Indonesia brought about sweeping liberalization of trade policy in the 1980s, Malaysia had removed most of its quantitative restrictions and initiated a phase of completing comprehensive trade reforms in 1985, and Philippines and Thailand had vigorously followed a policy of import substituting industrialization in the past while they undertook measures to promote exports in the 1980s.

changes in their respective tradable goods prices.

The results of this paper could be relevant to the ongoing policy discussion regarding the impact of exchange rate changes on developing countries' trade balance (often trade deficits). While the short-run effects of changes in the exchange rate on the balance of trade of a county may indeed be perverse (as shown above), in the long-run the impact of exchange rate changes on trade volumes are expected to be sufficiently large so as to insure that the depreciation of the domestic currency will improve the devaluing country's trade deficit. Number of factors may explain the persistence of the J-curve effect. In the short-run, a combination of price and volume effects following a currency depreciation may increase a country's spending on imports by more than it increases its export earnings, thus accounting for the observed J-curve effect. Furthermore, if a devaluation is undertaken from a position of severe disequilibrium that lasted for a number of years (such as the currency misalignments and large current account deficits that coexisted in certain East Asian countries in the pre-1997 period) then a devaluation will likely result in an initial deterioration of the trade balance. Furthermore, differences in the degree of the restrictiveness of devaluing countries trade regimes also may affect the duration of the J-curve effect.

Finally, as far as policy implications are concerned, our results underscore the importance for countries, such as those in East Asia to practice sound macroeconomic policies so that currency misalignments that may lead to a serious currency crises can be averted. This study also highlights the importance of developing countries adopting a more flexible approach to exchange rate management coupled with a more open and liberal policies towards trade and financial flows. A movement toward a freer exchange rate regime (from a fixed exchange rate regime) may accentuate the J-curve effect so long as domestic prices adjust more readily to changes in exchange rate under a flexible exchange rate regime than under a fixed rate regime. A policy shift to a freer exchange rate regime, accompanied by liberalization of the trade sector in particular and the economy in general, may dampen the J-curve effect if real variables react faster to price changes.

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References

Akaike, H. (1969), "Fitting Autoregressive Models for predictions," *Annals of International Statistics and Mathematics*; pp 243-247.

Backus, David K. (1993), "The Japanese Trade Balance: Recent History and Future Prospects," Paper prepared for *Trade Policy and Competition,"* Tokyo, Japan.

Bahmani-Oskooee, Mohsen and J. Alse (1994), "Short-Run Versus Long-Run Effects of Devaluation: Error Correction Modeling and Cointegration," *Eastern Economic Journal*, Fall; pp 453-464.

Bryant, R. C. and G. Holtman (1987), "The External Deficit: Diagnosis, Prognosis, and Cure,"

Brookings Discussion Papers in International Economics, 55,Washington D. C.: Brookings Institution, March.

Caves, R. E., J. A. Frankel, and R. W. Jones (1996), *World Trade and Payments: An Introduction,* HarperCollins Publishers Inc. New York, NY.

Dean, J. M., S. Desai, and N. Reifel (1994), "Trade policy reform in developing countries since 1985." Discussion Paper No. 267; Washington D. C.: The World Bank.

Demirden, T. and I. Pastine (1995), "Flexible Exchange Rates and the J-Curve," *Economic Letters,* pp 373-377.

Engel, R. F., and C. W. J. Granger (1987), "Cointegration and Error Correction Representation Estimation and Testing," *Econometrics*, 55, March; pp 251-276.

Feldstein, Martin (1987), "Correcting the Trade Deficit," Foreign Affairs, 65, Spring; pp 791-806.

Goldstein, Morris (1998), *The Asian Financial Crisis: Causes, Cures, and Systemic Implications,* Institute for International Economics, June.

Harvey, A.(1991), *The Econometrics Analysis of Time Series,* MIT Press, , Cambridge, MA.

Hutchinson, M. and C. Piggot (1984), "Budget Deficits, Exchange Rates, and the Current Account: Theory and U. S. Evidence," *Federal Reserve Bank of San Francisco Economic Review,* Fall.

International Monetary Fund (1995), *Direction of Trade Statistics,* Washington D. C.: IMF.

________________________ (1997), *World Economic Outlook*, October; pp. 78-97; Washington D. C.: IMF.

________________________ (1997), *International Financial Statistics* CD-ROM, September; Washington D. C.: IMF.

Johansen, S, and K. Juselius (1990), "Maximum Likelihood Estimation and Inference of Cointegration With Applications to Demand for Money," *Oxford Bulletin of Economics and Statistics,* May; pp 169-210.

Junz, H. and R. R. Rhomberg (1973), "Price Competitiveness in Export Trade among Industrial Countries," *American Economic Review,* Paper and Proceedings 63, May;

pp 412-418.

King, R. G. and C. I. Plosser, J. H. Stock, and M. W. Watson (1991), "Stochastic Trends and Economic Fluctuations," *American Economic Review*; pp 819-840.

Krugman, P. and R. E. Baldwin (1987), "The Persistence of the U. S. Trade Deficit," *Brookings Paper on Economic Activity*; pp1-58.

Krugman, P. and M. Obstfeld (2000), *International Economics*, Fifth Edition; Addison-Wesley, , Reading, MA.

Mackinnon, James G. (1991), "Critical Values for Cointegration Tests," in R. F. Engel and C. W. Granger (eds.) *Long Run Relationships in Cointegration* pp 267-287; Oxford University Press, Oxford, U.K.

Mehra, Y. P. (1993), "Unit Labor Costs and the Price Level," *Federal Reserve Bank of Richmond Economic Quarterly*, Fall; pp 35-49.

Mundell, R. A. (1987), "A New Deal on Exchange Rates," paper presented at Japan-United States Symposium on Exchange Rates and Macroeconomics, January 29-30; Tokyo, Japan.

Rose, A. K. (1990), "Exchange Rates and the Trade Balance: Some Evidence from Developing Countries," *Economic Letters*; pp 271-275.

Rose, A. K. and J. L. Yellen (1989), "Is There a J-Curve," *Journal of Monetary Economics*; pp 53-68.

Sedgley, N. and J. Smith (1996), "An Analysis of U. K. Imports Using Multivariated Cointegration,"*Oxford Bulletin of Economics and Statistics*, 56; pp 135-150.

United Nations Conference on Trade and Development (1998), *Trade and Development Report, 1998*, United Nations, Geneva.