U.S. BILATERAL NOMINAL TRADEBALANCE WITH INDIA, JAPAN, MALAYSIA, S. KOREA AND THAILAND, AND BILATERAL NOMINAL EXCHANGE RATE DYNAMICS: EVIDENCE ON J-CURVE?

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ABSTRACT

This paper re-examines the effects of bilateral nominal exchange rate changes on U.S. bilateral nominal trade balances with India, Japan, Malaysia, South Korea and Thailand using monthly data from January 1985 through May 2005. The unit root tests, Johansen-Juselius cointegration procedure and the error-correction model are implemented. Each variable is nonstationary in level depicting I (1) behavior. Either λ_{trace} or λ_{max} test confirms cointegrating relationship between the above variables. There is evidence of long-run unidirectional causal flow from exchange rate changes to the changes in U.S. trade balance with each country with short-run interactive feedback relationships. Impulse response analysis exhibits no evidence to support the J-Curve hypothesis excepting Japan.

INTRODUCTION

This paper re-explores the dynamic causal relationships between the U.S. bilateral nominal trade balance with India, Japan, Malaysia, S. Korea and Thailand, and the bilateral nominal exchange rates using monthly data from January, 1985 through May, 2005. This issue is of increasing importance for the U.S.A. because, since 1981, its annual trade deficit has been consistently escalating (Krugman and Baldurin 1987). The recent fall of U.S. dollar against other major currencies during 2007 also sparks renewed interest in this topic. The U.S.A. pursues freer trade policy and in large measures allows its exchange rate to be determined by the market forces. Though a strong dollar is its declared policy, a weak dollar benefits it by promoting exports and reducing imports. However, these do not happen instantaneously. For example, the weak dollar provides protection to the ailing U.S. auto industry neutralizing the demand for trade restrictions and subsidy. Asia, in general, has been a major destination for U.S. exports. The above countries have been selected because of their strong and enhancing trade relationships with the U.S.A. These countries experienced robust economic growth throughout 1980s and 1990s excepting a brief period after 1997-98 Southeast Asian financial crisis. However, Japan was a notable exception because it went through a prolonged recession from 1988 until 2001. Currently, the U.S.A. has its largest trade deficit with China, but it was excluded from this study because it adopted a fixed exchange rate against the U.S. dollar until September 2005.

In theory, exchange rate depreciations would reduce imports and increase exports thereby reducing a country's trade deficit. But the effects of exchange rate depreciations on exports and imports are not instantaneous. In fact, they reveal lagged responses to exchange rate adjustments. Magee (1973) pioneered the J-curve theory to describe the effects of exchange rate depreciations on the trade balance. According to this theory, a country's trade deficit worsens just after its currency depreciates because price effects will dominate the effect on volume of imports in the short run. In other words, the higher cost of imports will more than offset the reduced volume of imports. Thus, the J-curve depicts that a decline in the value of U.S. dollar against another currency should be followed by a temporary worsening in the U.S. trade deficit before its longer-term improvement.

The remainder of the paper is followed by a brief survey of the recent related literature, empirical methodology, analyses of results, and conclusions.

BRIEF SURVEY OF SOME RECENT LITERATURE

The vast and expanding empirical literature on the J-Curve hypothesis is anecdotal. But the evidences are mixed. This paper briefly surveys the relatively recent empirical literature on this topic. Rose and Yellen (1989) studied the short-run dynamics between exchange rate and trade balance. They found no evidence of the J-curve for G-7 countries. Rose (1990) examined the relationship for a sample of developing countries and found no evidence of the J-curve. Wilson and Tat (2001) did not find any evidence of the J-curve for Singapore. Lal and Lowinger (2002) did not find any evidence of the J-curve for Japan. Bahmani-Oskooee and Ratha (2004) considered 18 major trading partners of the United States (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland and U.K.) and were unable to discover any J-curve pattern in the short run, although real depreciation of dollar revealed favorable effects on the U.S. trade balances in most cases.

In contrast, Mahdavi and Sohrabian (1993) found evidence of a delayed J-curve for the USA. Demirden and Pastine (1995) also found evidence of the J-curve for the USA. Kale (2001) found evidence of the J-curve for Turkey. Lal and Lowinger (2002) found evidence of the J-curve for a group of 7 East Asian countries (Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore and Thailand). Narayan (2004) concluded that New Zealand's trade balance exhibited a J-curve pattern following a depreciation of the New Zealand dollar. More recently, Rahman and Islam (2006) found weak evidence on the J-Curve hypothesis for Bangladesh using quarterly data from 1972 through 2003 with significant short-run deterioration in trade balance and a sluggish improvement in the long-run.

EMPIRICAL METHODOLOGY

In the context of the J-Curve, only two variables are involved in the estimating model as follows:

$$TB = f(e) \tag{1}$$

where, TB = U.S. bilateral nominal trade balance (nominal merchandise exports-nominal merchandise imports) and e = bilateral nominal exchange rate (each sample country's currency per unit of U.S. dollar). As the U.S. dollar is the denominator currency, a decline in the exchange rate means depreciation of U.S. dollar. As a result, TB and e are conjectured to be negatively related.

First, the time series properties of each variable are investigated by implementing the modified DF (Dickey-Fuller) test, and modified (Ng-Perron) test respectively following Elliot et al. (1996), and Ng and Perron (2001). Following Kwiatkowski, et al., (1992), the KPSS test is also applied. To clarify, the modified DF and PP tests are about data non-stationarity assuming a unit root in each time series while the KPSS test is about data stationarity assuming no-unit root in each time series. For a time series variable to be nonstationary i) its variance must be time-variant and go to infinity as time approaches infinity, ii) it must depict no long-run mean-reversion, and iii) theoretical autocorrelations must not decay but the sample correlogram must die out slowly in finite samples. Second, to be cointegrated, all variables must have the same order of integration as per Engle and Granger (1987). They reveal I (1) behavior, if stationarity is induced on the first-differencing of the level data.

Third, the cointegrating relationship (the tendency for variables to move together in the long run) between the variables is determined by using the VAR approach as developed in Johansen (1988, 1991), and Johansen and Juselius (1990, 1992). The appropriate lag-length (P) is selected with the aid of the FPE (Final Prediction Error) criterion following Akaike (1969) to ensure that the errors are white noise. This helps overcome the problem of over- and under-parameterization that may induce bias and inefficiency in the estimates. The analysis commences with a congruent statistical system of unrestricted reduced forms as follows:

$$Y_t = \mu + \sum_{i=1}^{P} \pi Y_{t-i} + \xi_t;\ \xi_t \sim IN(0,\Omega), \text{i} = 1,2,\ldots\ldots,\text{T} \qquad (2)$$

where, Y_t is an (n×1) vector of I (1) and /or I (0) variables (here, U.S. nominal bilateral trade balance and exchange rates), and μ is an (n×1) vector of constraints. Letting $\Delta Y_t = Y_t - Y_{t-1}$, a convenient reparameterization of equation (2) is given by:

$$Y_t = \mu + \sum_{i=1}^{P-1} \Pi \Delta Y_{t-i} + \Pi Y_{t-P} + \xi_t \qquad (3)$$

Since ξ_t is stationary, the rank, r, of the long run matrix π determines how many linear combinations of Y_t are stationary. If r = n, all Y_t are stationary, while if r = 0 so that $\pi = 0$, ΔY_t is stationary as are all linear combinations if $Y_t \sim I\,(1)$. For $0<r<n$, there exist r cointegration vectors meaning r stationary linear combinations of Y_t. If this is the case, $\pi = \alpha\beta'$, where both α and β are n×r matrices. The cointegrating vectors of β are the error-correction mechanisms in the system, while α contains the adjustment parameters.

The cointegrating rank, r, can be formally tested with maximum eigenvalue test (λ_{max}) and the trace test (λ_{trace}). They are computed as follows:

$\lambda_{\max} = -T \ln(1 - \hat{\lambda}_{r+1})$ where, the appropriate null is r = g cointegrating vectors with (g = 0,1,2,3,…..) against the alternative that $r \le g+1$.

$\lambda_{trace} = -T \sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i)$ where, the null is r = g against the more general alternative $r \leq n$.

If cointegration is detected, the relevant error-correction term (EC_{t-1}) obtained from the cointegration regression must be included in the standard causality test to avoid the problem of misspecification. The usual t-test is applied to the coefficient of the one-period-lagged error-correction term (EC_{t-1}). The associated t-statistics indicates the existence of long-run causality, while the significance of joint F-statistics indicates the presence of short-run causality. The estimating error-correction model is specified as follows:

$$\Delta TB_t = \alpha_t + \sum_{i=1}^{n} \Pi_i \Delta TB_{t-i} + \sum_{i=1}^{K} \theta_i \Delta e_{t-i} + \gamma EC_{t-1} + v_t \qquad (4)$$

The estimated coefficient of the error-correction term is expected to be negative and statistically significant for a long-run converging causal flow stemming from the exchange rate changes to the changes in U.S. bilateral nominal trade balances. Finally, impulse response analysis is also performed in this paper on the trade balance by an exchange rate shock of $\pm 2\delta$ within a 95 percent confidence band. This shows the effects of exchange rate shock on the above variable and the duration of such effects.

Monthly data are used from January, 1985 through May, 2005 for higher data frequency. Moreover, this was a period of relative U.S. economic stability. The trade balance data have been obtained from the U.S. Census Bureau. The exchange rate data are obtained from the Federal Reserve, St. Louis Research.

RESULTS AND ANALYSIS

The unit root test results are reported in Tables 1, 2, and 3. As observed in Table 1, there is an evidence of nonstationarity in each time series variable in terms of both modified DF and Ng-Perron tests as their computed values are less than their critical values at 1 percent and higher levels of significance. The null-hypothesis of no-unit root is also resoundingly rejected for all variables by the KPSS test with some minor exceptions. The first-differencing of the level data on each variable restores stationarity revealing I (1) behavior.

Either λ_{trace} or λ_{max} test for all the aforementioned countries unveil a cointegrating relationship between U.S. bilateral nominal trade balance and bilateral nominal exchange rates at 5% level of significance. This inference is drawn by rejections of the null hypothesis of no cointegration as the computed values of the above tests are larger than their critical values.

Since there is evidence of cointegration, the estimates of the error-correction model (4) following Engle and Granger(1987) are reported as follows:

The coefficients of the error-correction term have the expected negative sign and the associated t-value is statistically significant. This shows a long-run unidirectional causal flow from exchange rates changes to trade balance changes with an exception of Japan. Exchange rate depreciation thus improves U.S. trade balance in the long run. There is evidence of short-run interactive feedback relationships between bilateral nominal trade balances and bilateral nominal exchange rates in all five countries.

The impulse response analysis (Appendix-I) unveils weak evidence of J-curve phenomenon in the case of Japan (Fig b). There is no such evidence in the cases of India, Malaysia, S. Korea and Thailand. In other words, exchange rate changes unleash uncharted effects on the U.S. nominal trade balances with these countries in violations of the J-curve hypothesis. These findings are consistent with those of Meade (1988) and Bahmani-Oskooe and Ratha (2004), among others.

TABLE 1
MODIFIED DICKEY-FULLER, Ng-PERRON, AND KPSS TESTS*

COUNTRY		LEVEL			DIFFERENCES		
INDIA	**SERIES**	**DF-GLS**	**Ng-PERRON**	**KPSS**	**DF-GLS**	**Ng-PERRON**	**KPSS**
	Trade Balance	1.1945	1.9878	1.9793	-0.2261	3.6268	0.36185
	Exchange Rate	-0.81235	-0.84697	0.2558	-12.40599	-7.7004	0.2145
COUNTRY		**LEVEL**			**DIFFERENCES**		
JAPAN	**SERIES**	**DF-GLS**	**Ng-PERRON**	**KPSS**	**DF-GLS**	**Ng-PERRON**	**KPSS**
	Trade Balance	-0.4671	-0.8833	1.4266	-0.3831	-1.5767	0.0198
	Exchange Rate	0.2760	0.3537	1.0513	-1.6240	2.1922	0.5399
COUNTRY		**LEVEL**			**DIFFERENCES**		
MALAYSIA	**SERIES**	**DF-GLS**	**Ng-PERRON**	**KPSS**	**DF-GLS**	**Ng-PERRON**	**KPSS**
	Trade Balance	-1.1406	-1.1025	0.2046	-4.5664	4.9036	0.05016
	Exchange Rate	-1.677	-1.6589	0.2553	-12.273	-7.3018	0.07263
COUNTRY		**LEVEL**			**DIFFERENCES**		
SOUTH KOREA	**SERIES**	**DF-GLS**	**Ng-PERRON**	**KPSS**	**DF-GLS**	**Ng-PERRON**	**KPSS**
	Trade Balance	-2.1943	-2.1254	0.4275	-15.8328	-9.0243	0.0550
	Exchange Rate	-1.9857	-1.9861	0.2281	-12.0081	-10.3751	0.0785
COUNTRY		**LEVEL**			**DIFFERENCES**		
THAILAND	**SERIES**	**DF-GLS**	**Ng-PERRON**	**KPSS**	**DF-GLS**	**Ng-PERRON**	**KPSS**
	Trade Balance	-5.8688	-5.2154	0.01240	-10.43558	-0.6455	0.07488
	Exchange Rate	-2.0731	-2.0676	0.3075	-11.5543	-7.3561	0.05921

*The modified Dickey-Fuller (DF-GLS) critical values are -2.653. -1.954 and -1.609 at 1%, 5% and 10% levels of significance respectively. The modified Phillips-Perron (Ng-perron) critical values are -13.80, -8.10 and -5.70 at 1%, 5% and 10% levels of significance respectively. The KPSS critical values are 0.739, 0.463 and 0.347 at 1%, 5% and 10% levels of significance respectively. h

TABLE 2
JOHANSEN-JUSELIUS COINTEGRATION WITH EXCHANGE RATE

		INDIA		JAPAN	
VARIABLE	**HO:**	λ_{max}	λ_{trace}	λ_{max}	λ_{tarce}
TB	r = 0	13.3543*	15.5877*	29.8248*	32.1689*
	r ≤ 1	2.2334	2.2334	2.3441	2.3441
		MALAYSIA		**S. KOREA**	
VARIABLE	**HO:**	λ_{max}	λ_{trace}	λ_{max}	λ_{tarce}
TB	r = 0	8.4666	8.7203*	11.6330	19.2775*
	r ≤ 1	0.2536	0.2536	7.644	7.6444*
		THAILAND			
VARIABLE	**HO:**	λ_{max}	λ_{trace}		
TB	r = 0	18.0115*	19.0691*		
	r ≤ 1	1.0576	1.0576		

The critical values of λ_{max} and λ_{trace} at 95 percent confidence level are 15.4947 and 3.8415 respectively. * indicates presence of cointegrating equation(s).

TABLE 3
ESTIMATES OF ERROR-CORRECTION MODELS

	DEPENDENT VAIABLE	EC_{t-1}	$\sum_{i=1}^{n}\Delta X_{t-i}$	$\sum_{i=1}^{k}\Delta e_{t-i}$	$\sum_{i=1}^{n}\Delta M_{t-i}$	$\sum_{i=1}^{n}\Delta TB_{t-i}$
INDIA	ΔTB_t	-0.1167 (-2.0689)	-	1.8461	-	12.8905
JAPAN	ΔTB_t	-0.0180 (-1.0663)	-	6.6306	-	10.7921
MALAYSIA	ΔTB_t	-0.0562 (-2.2546)	-	1.9338	-	4.8628
S. KOREA	ΔTB_t	-0.0964 (-2.9074)	-	24.8516	-	18.0997
THAILAND	ΔTB_t	-0.1424 (-3.2784)	-	4.5782	-	12.1075

The associated t-values of the error-correction terms are reported in parenthesis. Σ indicates the total of the coefficients.

CONCLUSIONS

To summarize, U.S. trade balances and exchange rates with India, Japan, Malaysia, S. Korea and Thailand are nonstationary in levels with I (1) behavior, based on modified DF, Ng-Perron and KPSS tests. Either λ_{trace} or λ_{max} test confirms long-run equilibrium relationship of bilateral nominal exchange rates with U.S. bilateral nominal trade balances with all the above countries. The estimated error-correction model divulges a long-run unidirectional causal flow from bilateral nominal exchange rates changes to U.S. bilateral nominal trade balances with four countries excepting Japan. Additionally, there are evidences of short-run interactive feedback relationships between the variables. The evidence on J-curve is non-existent in all other countries excepting Japan.

The policy of exchange rate depreciation to improve U.S. bilateral nominal trade balance in the long run seems effective only in the case of Japan because both countries are industrially developed and they pursue flexible exchange rates policy. Other countries' currencies are not fully convertible on both current and capital accounts. They also impose some exchange rate restrictions from time to time. As a result, this policy seems unlikely to work for other four countries. They are also much less developed than the US.A. Moreover, the success of a depreciating exchange rate policy is conditional upon meeting the well-known Marshall-Lerner condition (the sum of export and import demand elasticities should exceed unity).

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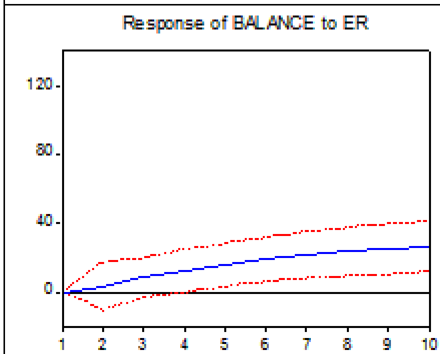
APPENDIX-I

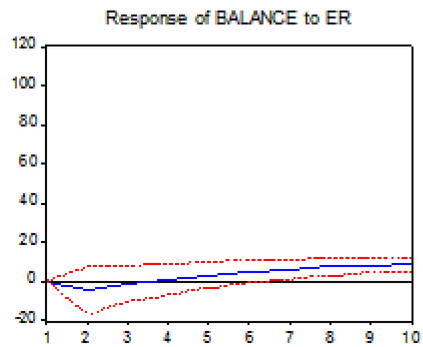
Impulse Response Functions

INDIA
Response to Cholesky One S.D. Innovations
± 2 S.E.



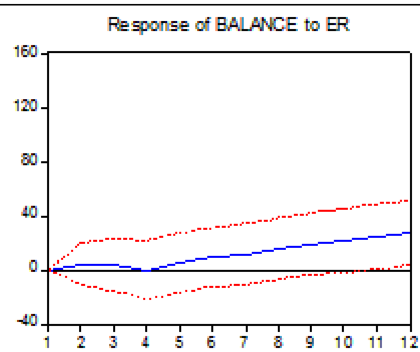
(a)

JAPAN
Response to Cholesky One S.D. Innovations
± 2 S.E.



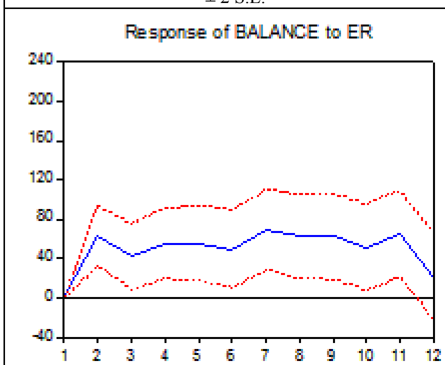
(b)

MALAYSIA
Response to Cholesky One S.D. Innovations
± 2 S.E.



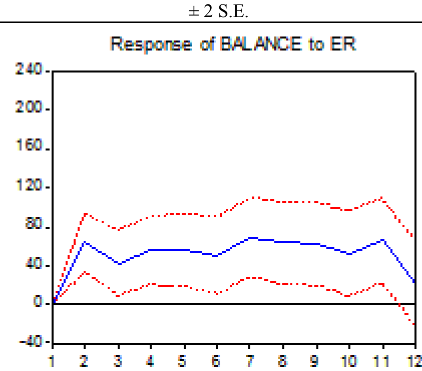
(c)

SOUTH KOREA
Response to Cholesky One S.D. Innovations
± 2 S.E.



(d)

THAILAND
Response to Cholesky One S.D. Innovations
± 2 S.E.



(e)