The J-Curve Phenomenon: Myth or Reality? – An Analysis for India

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In late 1992, pound sterling was devalued by nearly 15% following UK's exit from the European Exchange Rate Mechanism. This was expected to provide a welcome boost to the competitiveness of UK producers. But in the short term, the balance of trade actually worsened. Import volumes remained steady but were more expensive following the decline in the exchange rate. Exports took time to respond to the more competitive value of sterling.

However, in 1993-94 there was a clear acceleration in export volumes and a slower growth of imported goods and services as the effects of the exchange rate depreciation started to take effect. The net result was an improvement in the balance of trade in goods, although not sufficient to take the balance from deficit into surplus.

The above findings in the British economy can be explained by a phenomenon called the J- curve effect. It is expected that a rise in the exchange rate of a currency against another will lead to an improved trade balance. The effect of the depreciation is a fall in the price of exports compared to imports. This eventually induces an expansion of exports and a cut in imports which, in turn, will improve the current account. Thus, a depreciation of a country's currency should, in the long run, lead to a fall in the current account deficit. However, in the short run the above hypothesis may not hold true. Due to the low price elasticity of demand for both exports and imports, in the short run, a rise in the exchange rate may in contrast result cause deterioration in the balance of

trade. The balance of trade however improves with time as demand adjusts to the change in prices. These dynamics of the response of balance of trade to currency depreciation will trace out a j-shaped time path. J. Magee (1973) labeled this phenomenon as the J curve effect.

The impacts of devaluation on the trade balance are, by and large, analyzed by price and volume effects. As a result of currency depreciation imports will be more expensive and exports will be cheaper in the short run. Since the volume of imports and exports will not alter sharply, the trade balance worsens in the short-run. This subdued volume effect in the short run can be attributed to the fact that at the time an exchange occurs, there are goods which are already in transit and under contract. In the long-run, however, if the Marshall-Lerner condition holds, i.e. sum of domestic and foreign price elasticities of demand (in absolute value) is greater than one, the volume effect takes over and reverses the effect, and the trade balance improves.

The trade balance is defined as the difference between value of exports and value of imports.

Mathematically, **TB = P_e*Exp - eP_i*Imp.**

Where $\mathbf{P_e}$ is the domestic export price in domestic currency and $\mathbf{P_i}$ is the foreign export price in foreign currency. Where, e represents the exchange rate.

$$\frac{dTB}{de} = \mathbf{Pe}.EXP\left[\frac{(1+\in)\rho *}{(\in +\rho)}\right] - e\ .\mathbf{Pi}.IMP\left[\frac{(1-\rho)\ \in *}{(\in * +\rho)}\right]$$

Where, ρ and ρ* denote the absolute value of the domestic and foreign price elasticity of demand respectively and ε and ε* denote the absolute value of the domestic and foreign price elasticity of supply respectively.

The given equation is known as the Bickerdike-Robinson-Metzler (BRM) condition. If trade is in balance (TB =0) in an initial equilibrium, and both supply elasticities are infinite i.e. ε and ε* tend to infinity the BRM condition reduces to the well-known Marshall-Lerner condition. It says country's devaluation can improve a trade balance [$\frac{dTB}{de} > 0$] when the sum of domestic and foreign price elasticities of demand (in absolute value) exceeds one i.e. ρ+ρ*>1.

The J-curve theory states that the dynamics of trade balance after devaluation can be divided into three parts: the currency-contract period, the pass-through period, and the quantity-adjustment period. The current-contract period is defined as the brief period immediately following devaluation in which contracts negotiated before the change are executed. The pass-through period or the value effect period is the period after devaluation in which prices can change but quantities of exports and imports remain unchanged. The quantity-adjustment period or the price effect period is defined as the period in which quantities start to adjust in response to changes in prices.

In the pass through period i.e. in the short run, both domestic and foreign demands are inelastic. In that case the BRM condition reduces to,

$$\frac{dTB}{de} = \mathbf{Pe}.EXP - e\,.\mathbf{Pi}.IMP$$

The above equation indicates than in the period where demands are price inelastic, the import price measured in domestic currency (e.P_i) increases but the demand stays the same, thereby resulting in an increase of value of imports. On the other hand, the export price in foreign currency decreases by the same proportion of the exchange rate variation (full pass-through) whereas the export price in domestic currency P_e remains unchanged.

This leads to deterioration in trade balance in the short run. Also it can be seen from the original BRM condition that during the quantity- adjustment period as price elasticities of demands increase, balance of trade will eventually improve as long as the Marshall-Lerner condition is satisfied. This combination of the pass through effect in the short run and the quantity adjustment effect in the long run will induce a j- curve pattern in the trade balance on devaluation of the domestic currency.

Analysing the J- curve effect is an interesting topic to research upon as it can lead to short run deflation or inflation in the economy (Dornbusch and Krugman 1976). Monetary and fiscal policies for stabilization must deal with additional problems of foreign exchange market instability (Ueda 1983). Thus, macroeconomic stabilization policies should be framed taking the j curve effect into account. For example, large current account deficits are often corrected by exchange rate depreciation. However, in presence of the j curve phenomenon, depreciation may not have the desired effect in the short run.

This paper looks to test the j curve hypothesis using disaggregated Time series data for India's trade with her three major trading partners. Historically, the Indian rupee was a silver-based currency, while the major economies of the world were following the gold standard. The value of the rupee was severely impacted when large quantities of silver was discovered in the US and Europe. After initially following a pegged exchange rate system, it was forced to go through several rounds of devaluation from the 1960s to the early 1990s due to war and balance of payments problems.

Trade liberalization undertaken in 1991 has been accompanied by changes in the monetary policies. As a result from 1991–1992 to 1998–1999, the rupee has declined from 19.62 rupees per dollar to 42.48 rupees per dollar. By December 2000 rupee had further

devalued to 46.25 per dollar. Such depreciation was expected to give a boost to India's balance of trade.

The recent stability of the Indian economy has attracted a large volume of Foreign Direct Investment. In addition, the high interest rates have led to the rupee to a ten year high of 39.29 rupees per dollar in June 2000. However, during the recent global financial crisis, the pressure on crude oil prices meant that the dollar inflow declined. This led to a consistent depreciation of the rupee during the crisis period. The Rupee fell by over 20% between September 2007 and its low point in March 2009. It recovered slightly, but in January 2010 was still more than 12% below its September 2007 level.

According to experts, India should continue to adopt a low exchange rate policy to stimulate exports still further. Also, given India's importance in the world economy and its shift towards a policy of high savings and high investment coupled with a low exchange rate to stimulate exports, analysing the exchange rate of the Rupee, and its effect on India's economic performance has become an issue of increasing interest.

In this paper we aim to test this j curve hypothesis for India's trade with her three different trading partners, i.e. US, UK and Japan. Previous studies on India have failed to find any j-curve effects on India's trade balance. Researchers have argued that the problem might be the use of aggregated data. However this problem was taken care of by Bahmani-Oskooee et al. (2003) who conducted a study using disaggregated Quarterly data over 1977I-1998IV period for India's seven major trading partners. The paper was again unable to find any significant j- curve pattern in India's balance of trade. We conduct a similar analysis using monthly data over the years 1992-2009, disaggregated across India's three major trading partners.

Literature Review

Since its introduction by Magee (1973) a large number of studies have attempted to test the phenomenon using different techniques and different model specifications. Some results are consistent with the J-curve phenomenon while others depict non existence or new evolution of the J-curve effect. Magee (1973) explains the J-curve pattern in terms of adjustment lags. He analyses the implications of currency-contracts, periods of pass-through and the sluggish quantity adjustments. Numerous other studies such as Cooper (1971), Connolly and Taylor (1972), Laffer (1976), and Salant (1976) have examined the J-Curve after that. Miles (1979) wrote a critique on these papers and accordingly, included monetary and fiscal policies alongwith growth rates in the analysis. He finds that devaluations do not improve the trade balance but they do improve the balance of payments through the capital account. Therefore, he suggests that devaluation causes a mere portfolio readjustment, resulting in a surplus in the capital account. Later, Himarios (1985) shows that devaluations do affect the trade balance in the traditionally predicted direction.

Bahmani-Oskooee (1985) introduces a method of testing the J-Curve uses the method on data for four countries, with different exchange rate regimes viz. Greece, India, Korea and Thailand. He finds evidence of a J-Curve for Greece, India, and Korea, though the duration of deterioration of the trade balance varies from one case to another. The long-run impact on the trade balance is favourable only in the case of Thailand. Brissimis and Leventankis (1989) develop a dynamic general equilibrium model that combines the elasticities and monetary approaches to the balance of payments. Haynes and Stone (1982) define trade balance as the ratio of a country's imports to exports. They employ the Engle-Granger

cointegration technique on quarterly data on the trade balance and real effective exchange rate of 19 developed and 22 less developed countries For Canada, Denmark, Germany, Portugal, Spain, Sri Lanka, UK and the USA, there is no long-run effect. Of the 41 countries, they could apply the cointegration technique to only 20 countries for which both the variables were found to be I(1). They note that some of the standard assumptions underlying the textbook style J-Curve are not met for the 1973–1986 US data. Rosensweig and Koch (1988) showed weak pass through effect and advocated a delayed J-Curve for the USA. Wassink and Carbaugh (1989) show further evidence of incomplete pass-through leading to a delayed J-Curve for the USA.

Meade (1988) recognized the drawbacks of using aggregate data, and investigates sectoral J-Curves. She says that the size and the timing of the aggregate adjustment of the trade balance will then depend on the size of the change in the exchange rate, the particular kind of trade involved; and on the characteristic rapid or sluggish response to exchange rate changes. Since then several studies have used disaggregated data for testing the J curve hypothesis.

Gupta-Kapoor and Ramakrishnan (1999) used the error correction model and the impulse response function to determine the J-curve effect on Japan using quarterly data. Their analysis showed the existence of the J-curve on the Japanese trade balance. Tihomir Stucka (2004) found evidence of J-curve on trade balance for Croatia. His study employed a reduced form model to estimate the impact of a permanent shock on the merchandise trade balance. Scott Hacker and Abdulansser Hatemi-J (2004) used bilateral trade data to estimate the short and long-run effect of exchange rate changes on the trade balance. They used the industrial production index as a proxy for foreign and domestic income. This

allowed them to estimate the statistical parameters using monthly data and there were no reliable and consistent data on GDP. Bahmani-Oskooee et al. (2003) conducted a study on India's trade balance following up on previous studies which did not find any significant results on the subject. He did not find any evidence of the J curve phenomenon in India. Bahmani-Oskooee and Mitra (2009) disaggregated the trade data between India and the U.S. at industry level and use trade data from 38 industries to show that in most industries while real depreciation of the rupee has short-run effects, the short-run effects last into the long run in almost half of these industries.

Data and Methodology

To test the relationship between exchange rate and trade balance we use the multivariate time series analysis. Cointegaration analysis will be conducted and the existence of cointegrating vectors will help answer part of our hypothesis about the long-run relationship. If found that exchange rate variable is positively related to the trade ratio, this entails that real depreciation will lead to a long-run improvement in the trade ratio. The other part of the hypothesis about the J-curve in the short run will be tested using the impulse response function.

Following Bahmani-Oskooee and Alse (1994), we define the trade balance as the ratio of M to X. As explained in their study, this ratio is not sensitive to the units of measurement. EXP and IMP are expected to be functions of domestic income, foreign income and exchange rate. The reduced form equation for long run relationship estimation in log-linear form is-

$$\ln\left[\frac{EXP}{IMP}\right] = a + b * ln(iip_{ind}) + c * ln\left(iip_f\right) + d * e + u$$

Where iip_{ind} and iip_f represent the Index for Industrial Production for India and the foreign trading partner respectively. Contrary to most previous studies, IIP is taken as a proxy for GDP as it is reported monthly instead of quarterly. Taking GDP would have reduced the number of observations. Estimating a VAR regression for such a small number of observations would have further reduced the degrees of freedom. Thus IIP is taken so as to make our results more robust. Another advantage of taking IIP over GDP is that it is unit free.

'e' is the bilateral exchange rate between India and the Trading partner. EXP and IMP represent the value of exports to the trading partner and the value of imports from the trading partner respectively. A vector auto regression (VAR) or vector error correction (VEC) model is estimated to test the short run j curve hypothesis. If a long run relationship between the variables exist a vector error correction (VEC) model is used to include the restrictions implied by the long run relationship.

In most of the studies done so far on the J-curve, attention is paid only to the direct effect and not to the feedback effect. However, feedback effects arise from a one-time change in exchange rate which will have an impact not only on the balance of trade, but also on the future exchange rate, which will in turn affect the balance of trade and so on. Further, there are additional feedback effects from other endogenous variables, such as domestic income and foreign income. These feedback effects are represented by the total derivative of the trade balance with respect to the exchange rate. These feedback effects of the exchange rate fluctuations are taken into account using a vector auto regression (VAR) and the impulse response function (IRF). The J-curve phenomenon is captured using the impulse response function.

All the variables are logged such that the parameter estimates would be interpreted as elasticities. We expect the trade ratio to be negatively related to the domestic real income and positively related to foreign income and the real effective exchange rate. Thus currency depreciation will lead to a decrease in the export-import ratio in the short run due to price effect. In the long run when the volume effect takes over, the trade ratio improves. An increase in demand for foreign goods put much constraint on the domestic income hence the negative relationship while exports bring in income from abroad increasing the value of trade balance.

The above analysis is done separately for each of the three trading partners for India viz. United States, United Kingdom and Japan. We use monthly data over the period of March 1992 to May 2009. Data for exchange rate is obtained from Reserve Bank of India website, whereas data for exports, imports and IIP for the various countries is obtained from the IFS database of the International Monetary Fund.

Results and Analysis

To capture the J curve effect we need to analyse both the long run and the short run effects of exchange rate on trade. The short run dynamics combine with the long run cointegrating relationship to trace a J shaped time path of the balance of trade. Unit root tests were conducted on log of each of the four variables for all the three trading partners to test for stationarity. Each variable was subjected to the augmented dickey fuller unit root test. The variables are log (IIP for foreign country), log (Balance of trade) and log (Bilateral Exchange Rate) for each trading partner and log (India's IIP). It was found that while the industrial production index for Japan and India's trade balances with Japan and UK turned

out to be stationary, the others were I(1). This implies that a cointegrating relationship can exist between the variables only for the United States. This is because a cointegrating relationship can be established only between non-stationary variables. In such a scenario, there is no indication of any long run relationship between trade balances and the bilateral exchange rates. Thus the hypothesis of any long run relationship between India 's bilateral trade balance and its bilateral exchange rate stands rejected for trading partners UK and Japan.

Johansen's likelihood ratio cointegration test was performed to test for a cointegrating relationship among the variables (IIP for India, IIP for the Trading Partner, India's bilateral Trade Balance with the Trading Partner and the Bilateral Exchange Rate). Johansen's test indicates the presence of one cointegrating vector. Thus there exists a long run relationship between the variables, viz. India's bilateral trade balance, the real exchange rate, and proxies' for real income. The results for the cointegration test are given in the appendix. The results indicate that in the long run a one percent increase in exchange rate will cause the trade balance to improve by 2 percent.

For the short run analysis we would estimate a two separate VAR models for India's trade with UK and Japan as there are no signs of any long run relationship. Short run effects of exchange rate on trade balance with US will be captured by a vector error correction (VEC) model. This is done so as to include the restrictions implied by the long run relationship.

The results for the VAR model for UK and Japan are given in the appendix. The VAR for UK is estimated by including 3 lags for each variable, where as only 1 lag is included in the VAR estimation for Japan. The lag length to be included is determined using various criterions. The criterions used are Akaike Information Criterion (AIC), Schwarz information criterion

(SIC), Hannan-Quinn information criterion (HQIC), Final Prediction Error (FPE) and the LR test. The results for these criterions are given in the appendix.

The results for the VAR analysis for India's trade with UK do not point to any direct causal link between Balance of Trade and exchange rate (Results given in the appendix). The coefficients for the effect of the exchange rate on trade balance turn out to be statistically insignificant for all lags of the exchange rate variable. The hypothesis for joint insignificance of the coefficients on different lags also cannot be rejected. Thus the causality test rules out any direct causal link between the rupee- sterling exchange rate and the bilateral trade balance for India. We try to capture the indirect effects of a change in exchange rate by the impulse response function. The impulse response function depicts how the bilateral trade balance react to an exogenous shock in the exchange rate. A one unit innovation in the exchange rate does not cause any change in the trade balance immediately, but leads to a slight fall in the second period. After a rise in the third period the effect of the shock gradually dies down in about a year. The overall effect is captured in the accumulated impulse response function. The composite effect is an extremely mild deterioration in trade balance lasting only for one period. However, at the given confidence level, the response of the trade balance is statistically insignificant. It should be noted that the wider the confidence interval the more insignificant the results become. We therefore reject the null hypothesis that the J-curve phenomenon exists on the Indo-UK bilateral balance of trade as any effect of exchange rate change on trade balance is statistically insignificant. Thus a significant relationship between bilateral trade balance and the rupee-sterling rate could be found neither in the short run nor in the longer run.

VAR results for trade with Japan are similar to those for UK in the sense that they also do not point to any causal link between the variables of interest. The impulse response function indicates that a one unit exogenous shock in the exchange rate leads to an extremely small rise in the second period followed by a fall in the third period. The effect gradually dies down over the next 6 months. Again the effect though reported, is statistically insignificant from zero. Thus there seems to be no response of trade balance to the shock in exchange rate. The accumulated response function also shows statistically insignificant responses.

As there was evidence of a long run relationship among variable for trade with US, a vector error correction (VEC) model is estimated to capture the restrictions implied by this long run relationship. The results do not indicate any short term direct causal link between bilateral trade balance and the rupee dollar rate. The null hypothesis of granger causality could not be rejected. The impulse response function and the accumulated impulse response function on the other hand predict a positive impact on the trade balance. The response of the shock does not seem to die down quickly. However, even though there exists a relationship between the variables of interest, there seems to be no evidence of the J curve phenomenon. For the J curve hypothesis to hold, the short run relationship between the two variables should be negative. Such a relationship is lacking in our results.

The j curve hypothesis is rejected in each of the three cases that we have studied. The results show that J curve effect does not exist for India's bilateral trade with the three trading partners analyzed in this study.

Conclusions

The paper tried to test the well known J-curve hypothesis using data on India's bilateral trade with three of her major trading partners. The methodology used cointegration tests to estimate the long run relationship and the impulse response function and VAR/VEC model to estimate the short run dynamics of the relationship between trade balance and bilateral exchange rate. The analysis is done separately for India's trade with Japan, US and UK.

Evidence of a positive long run relationship has been found only in one of the three cases, i.e. for US. Our tests have failed to detect any short run relationship characterizing the J curve effect. Many previous studies have also failed to find such a relationship between trade balance and exchange rate. Researchers have attributed the lack of empirical support to this theoretically well established phenomenon to a number of reasons.

(Nelson and Plosser 1982) claimed that the earlier evidence from conventional studies in favor of the J-curve may well have been spurious, since it was based on methodologies that did not deal with the problem of nonstationarity of the variables. A large number of recent studies have now detected unit roots unit roots and thus, require differencing to induce stationarity.

The assumption of a short-run inelastic response of import volumes to import prices may not be correct. Empirical evidence from a few devaluation episodes in developing countries has supported the phenomenon of "import compression" immediately following devaluation. This would mean that devaluation quickly forces a reduction in the volume of imports, presumably because of a binding foreign exchange constraint. In such a case there would no J-curve effect as it rests on the assumption that import volumes do not change in

the short run. Albert Duncan (2008) and Ratso(1994) examine this effects for developing economies. Rosensweig and Koch (1988) found that some of the standard assumptions regarding price and volume elasticities were not met empirically. The results contradicting the long run relationship between trade balance and exchange rate may be due to other factors influencing the trade balance.

There may be other reasons why the empirical results do not theory. To examine those, further research regarding the assumptions underlying the theory is required

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Appendix

Johansson's cointegration test for United States

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.158355	61.68646	47.85613	0.0015
At most 1	0.081356	26.86227	29.79707	0.105
At most 2	0.046965	9.721192	15.49471	0.3028
At most 3	2.11E-05	0.004262	3.841466	0.9467
Lags interval (in first differences): 1 to 4				

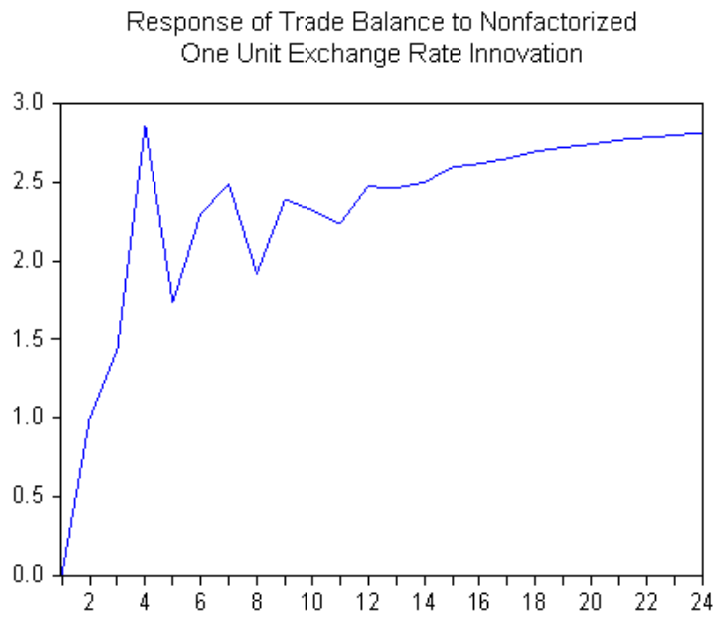
United States	**Cointegrating Equation**			
	Trade Bal	**Exchange Rate**	**IIP India**	**IIP US**
Coefficient	1	-2.03483	1.094376	-0.40074
Standard Error		-0.335	-0.21803	-0.66466
Log likelihood	2598.001			

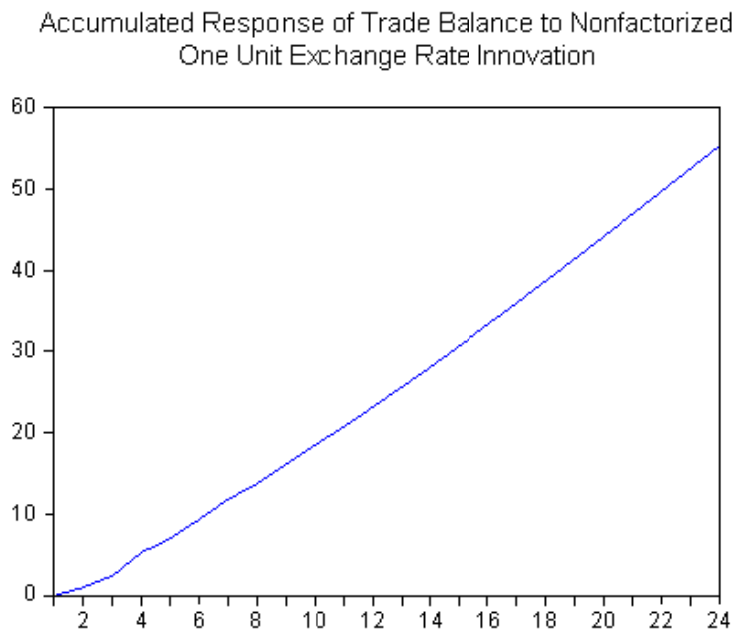
Error Correction model results for Trade with United States

Error Correction Model	D(USTRD)	D(USEX)	D(IIPIND)	D(IIPUS)
CointEq1	**-0.694**	**0.000**	**0.001**	**0.001**
	-0.121	-0.009	-0.011	-0.004
D(USTRD(-1))	**-0.123**	**0.001**	**-0.006**	**-0.002**
	-0.113	-0.008	-0.010	-0.004
D(USTRD(-2))	**-0.026**	**-0.002**	**-0.009**	**-0.002**
	-0.105	-0.008	-0.010	-0.003
D(USTRD(-3))	**0.136**	**-0.009**	**-0.009**	**-0.001**
	-0.091	-0.007	-0.009	-0.003
D(USTRD(-4))	**0.024**	**0.004**	**-0.003**	**-0.001**
	-0.073	-0.005	-0.007	-0.002
D(USEX(-1))	**-0.413**	**0.277**	**-0.119**	**0.000**
	-1.000	-0.074	-0.093	-0.032
D(USEX(-2))	**-0.448**	**-0.094**	**0.160**	**0.042**
	-1.044	-0.077	-0.097	-0.034
D(USEX(-3))	**0.542**	**0.097**	**0.038**	**-0.114**
	-1.041	-0.077	-0.097	-0.033
D(USEX(-4))	**-0.454**	**0.037**	**-0.032**	**-0.028**
	-1.007	-0.075	-0.094	-0.032
D(IIPIND(-1))	**0.540**	**-0.094**	**-0.342**	**0.061**
	-0.791	-0.059	-0.074	-0.025
D(IIPIND(-2))	**-0.756**	**-0.059**	**0.064**	**0.025**
	-0.831	-0.062	-0.077	-0.027
D(IIPIND(-3))	**0.173**	**0.029**	**-0.028**	**0.008**
	-0.823	-0.061	-0.077	-0.026
D(IIPIND(-4))	**0.077**	**-0.063**	**-0.110**	**-0.009**
	-0.760	-0.056	-0.071	-0.024
D(IIPUS(-1))	**4.370**	**-0.450**	**-0.019**	**-0.033**
	-2.303	-0.171	-0.214	-0.074
D(IIPUS(-2))	**0.636**	**-0.129**	**-0.072**	**0.188**
	-2.142	-0.159	-0.199	-0.069
D(IIPUS(-3))	**4.257**	**0.331**	**0.243**	**0.395**
	-2.177	-0.161	-0.203	-0.070
D(IIPUS(-4))	**2.479**	**0.301**	**0.263**	**0.064**
	-2.377	-0.176	-0.221	-0.076
C	**-0.009**	**0.001**	**0.003**	**0.000**
	-0.008	-0.001	-0.001	0.000

The numbers in black represent the coefficient estimates and those in blue are the standard errors.

Impulse Response Function (IRF) and the Accumulated Impulse Response Function for United States





Here, the X axis represents time periods and the y axis represents the response to the impulse. The blue line represents the impulse function.

Results for Vector Autoregression Model Estimation for trade with United Kingdom

VAR (UK)	UKTRD	DUKEX	DIIPIND	IIPUK
UKTRD(-1)	0.252	0.001	0.001	0.008
	-0.075	-0.007	-0.006	-0.006
UKTRD(-2)	0.239	0.004	0.004	-0.005
	-0.075	-0.007	-0.006	-0.006
UKTRD(-3)	0.178	-0.006	0.000	-0.006
	-0.075	-0.007	-0.006	-0.006
DUKEX(-1)	-0.548	0.302	0.106	0.009
	-0.814	-0.074	-0.063	-0.063
DUKEX(-2)	1.254	-0.245	0.157	0.029
	-0.833	-0.076	-0.064	-0.064
DUKEX(-3)	-0.598	-0.016	-0.012	0.047
	-0.830	-0.075	-0.064	-0.064
DIIPIND(-1)	1.957	0.019	-0.354	-0.069
	-0.985	-0.089	-0.076	-0.076
DIIPIND(-2)	0.377	-0.015	0.045	0.029
	-1.046	-0.095	-0.080	-0.081
DIIPIND(-3)	0.892	0.212	-0.028	0.004
	-0.939	-0.085	-0.072	-0.073
IIPUK(-1)	-0.867	-0.066	-0.015	-0.016
	-0.688	-0.062	-0.053	-0.053
IIPUK(-2)	0.254	0.160	0.008	0.221
	-0.638	-0.058	-0.049	-0.049
IIPUK(-3)	0.258	-0.040	0.013	0.687
	-0.672	-0.061	-0.052	-0.052
C	0.694	-0.105	-0.008	0.214
	-0.872	-0.079	-0.067	-0.067

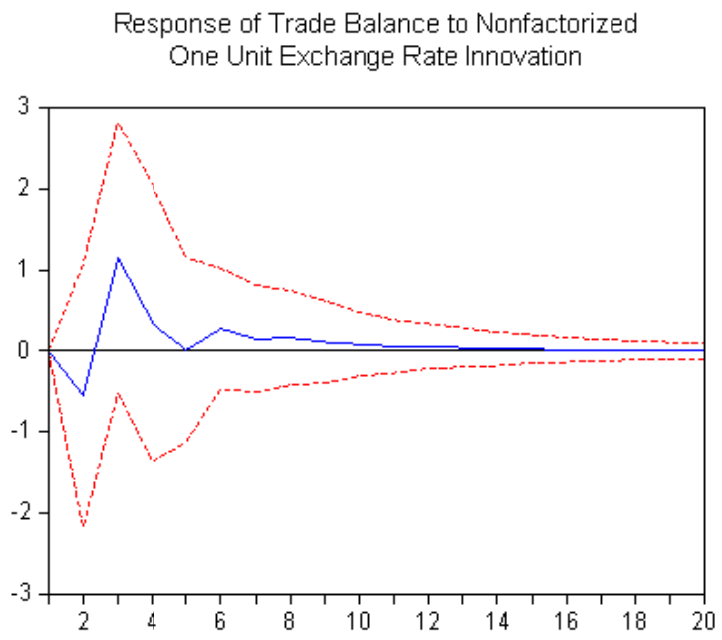
The numbers in black represent the coefficient estimates and those in blue are the standard errors

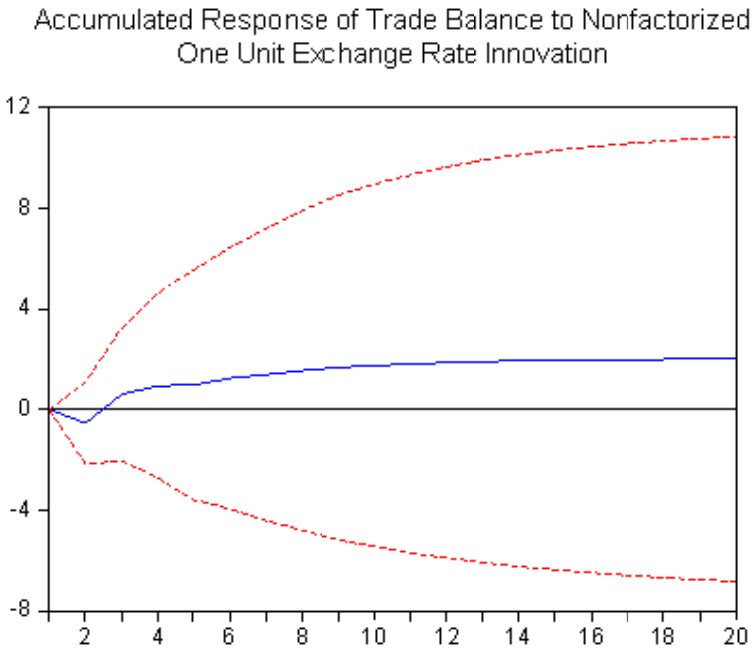
VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1841.662	NA	0.000	-20.084	-20.014	-20.055
1	1937.243	185.939	0.000	-20.953	-20.603	-20.811
2	1984.176	89.249	0.000	-21.292	-20.660	-21.036
3	2054.970	131.5301*	3.66e-15*	-21.890*	-20.978*	-21.520*
4	2060.251	9.582	0.000	-21.773	-20.581	-21.290
5	2070.242	17.689	0.000	-21.708	-20.234	-21.110
6	2082.452	21.083	0.000	-21.666	-19.912	-20.955
7	2093.767	19.044	0.000	-21.615	-19.581	-20.790
8	2104.759	18.020	0.000	-21.560	-19.245	-20.622

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Impulse Response Function(IRF) and the Accumulated Impulse Response Function for United Kingdom





Here, the X axis represents time periods and the y axis represents the response to the impulse. The blue line represents the impulse function. The red dotted line represents the 95% confidence band

Results for Vector Autoregression Model Estimation for trade with Japan

VAR(Japan)	JPTRD	DJPEX	DIIPJP	DIIPIND
JPTRD(-1)	**0.120848**	**0.006079**	**0.001986**	**-0.00055**
	-0.07365	-0.00267	-0.00161	-0.00186
JPTRD(-2)	**0.097292**	**0.001641**	**-0.002162**	**-5.46E-05**
	-0.0747	-0.00271	-0.00163	-0.00189
DJPEX(-1)	**0.970525**	**0.181935**	**-0.045963**	**-0.03346**
	-2.09293	-0.07589	-0.04569	-0.05299
DJPEX(-2)	**-3.095592**	**0.029291**	**0.046665**	**0.068372**
	-2.06372	-0.07483	-0.04506	-0.05225
DIIPJP(-1)	**-5.283646**	**0.0236**	**-0.537691**	**0.160729**
	-3.43089	-0.1244	-0.07491	-0.08687
DIIPJP(-2)	**-4.469311**	**-0.101909**	**-0.209845**	**0.051622**
	-3.34556	-0.12131	-0.07304	-0.08471
DIIPIND(-1)	**3.650208**	**-0.11668**	**0.055105**	**-0.32311**
	-2.94608	-0.10682	-0.06432	-0.0746
DIIPIND(-2)	**2.814828**	**-0.251311**	**0.02124**	**0.039899**
	-2.85206	-0.10341	-0.06227	-0.07222
C	**-0.063616**	**0.002283**	**0.000417**	**0.002889**
	-0.02638	-0.00096	-0.00058	-0.00067

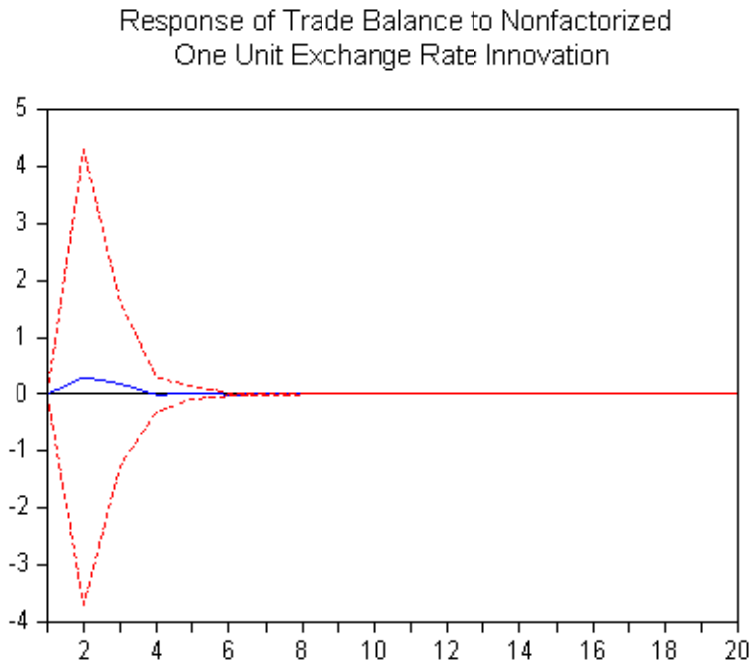
The numbers in black represent the coefficient estimates and those in blue are the standard errors

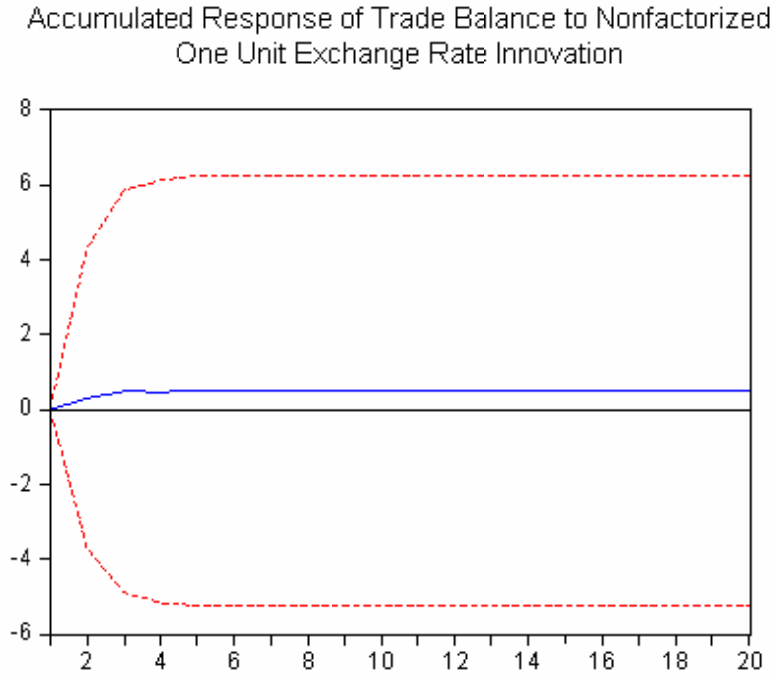
VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1749.13	NA	0.00	-19.07	-19.00	-19.04
1	1799.49	97.96	0.00	-19.45	-19.097*	-19.305*
2	1815.63	30.70	4.20e-14*	-19.4495*	-18.82	-19.19
3	1828.60	24.09	0.00	-19.42	-18.50	-19.05
4	1837.55	16.24	0.00	-19.34	-18.15	-18.86
5	1847.95	18.40	0.00	-19.28	-17.80	-18.68
6	1859.77	20.42	0.00	-19.23	-17.48	-18.52
7	1869.11	15.71	0.00	-19.16	-17.13	-18.34
8	1889.15	32.84876*	0.00	-19.20	-16.89	-18.27

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Impulse Response Function(IRF) and the Accumulated Impulse Response Function for Japan





Here, the X axis represents time periods and the y axis represents the response to the impulse. The blue line represents the impulse function. The red dotted line represents the 95% confidence band