The Short-Run Relationship between Real Effective Exchange Rate and Balance of Trade in China

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Abstract: This paper analyzes the short-run relationship between the real effective exchange rate and the balance of trade in China. We examined the causality between effective exchange rate and balance of trade with Granger-Causality test using the monthly data from January 1994 to August 2009. The test suggests that in the short run balance of trade causes a change in effective exchange rate but not vice versa. The uni-directional relationship between exchange rate and balance of trade compels the use of transfer function methodology. Transfer function estimation shows that a shock in balance of trade has a 3-4 month delayed effect on effective exchange rate in the short-run but this delayed effect dissipates in the long run.

Keywords: real effective exchange rate, balance of trade, causality and transfer function

JEL Classification: F14, F31

1. Introduction

There has been an increasing interest in the developing economies that have exhibited rapid growth due to the economic integration of these economies to the rest of the world. Several research articles have recently examined the trade performance of these countries. Some of these articles examined the effect of trade liberalization; yet others examined the effect of the exchange rate on trade performance of these developing countries.[1] From these countries, China is the one that attracts the attention the most since it has recently become third largest economy and has the third largest trade volume in the world as of 2008.[2] More recently, China and its trading partners have a heated debate on the value of Chinese Yuan. China has historically controlled value of Yuan in hopes to maximize the benefits from trading with the rest of the world.[3]

Economic theory suggests that there is a long run relationship between exchange rate and trade flows. Exchange rates reflect the evolution of relative prices across countries. Appreciation of a domestic currency makes foreign goods relatively cheaper which leads to an increase in imports in the long run. At the same time, this appreciation also makes domestically produced good relatively expensive for foreigners. Hence, ceteris paribus, an appreciation of a domestic currency decreases the trade balance of a country. Most of the earlier literature investigated this long-run adjustment between trade performance and exchange rates. For example, Bahmani-Oskooee (1991) examined the long-run relationship between trade balance (BOT) and exchange rate in least developed countries (LDCs). He found that BOT and exchange rates are cointegrated and he suggested that depreciation in a currency improves the trade balance of LDCs in the long run, consistent with the economic theory. Bahmani-Oskooee has also concluded that there is a uni-directional relationship such that exchange rate that affects the position of the trade balance and not the other way around. Recently, Bahmani-Oskooee (2010) has examined a similar relationship in Middle Eastern countries and supported his earlier findings. Moreover, Garcia-Herrero and Koivu (2009) examined the relationship between the trade balance and effective exchange rate in China. They estimated standard export and import equations and used cointegration techniques to examine the long-run relationships. They found that trade balance is sensitive to the changes in effective exchange rate. However, Garcia-Herrero and Koivu reported no formal tests indicating causality between these variables. Brada et al. (1993) have also examined the long run relationship between trade and exchange rate. They found that exchange rate influence the level of trade but this effect is observed only after 1 year and suggested that the exchange rate an effective indirect tool for regulating trade. In contrast, some of the earlier studies such as Rose (1990 and 1991) found no empirical evidence for the long run relationship between exchange rate and trade. Liew et al. (2003) supported Rose's findings suggesting that in the long run trade balance is affected by real money rather than exchange rate.

What is apparent in the literature is the fact that many empirical papers relying on long run theoretical underpinning of trade performance and exchange rate but ignoring the possible feedback effect from trade to exchange rate in the short run. This potential feedback can be illustrated as follows: Assume that the foreign exchange market is perfectly competitive where demand for foreign currency is downward sloping. This suggests that people in a given economy buy more foreign currency as it depreciates. In the mean time, the supply of foreign currency is upward sloping where people provide more of the foreign currency to the market as it appreciates. In other words, foreign currency is viewed as a normal good and people buy and sell the foreign currency based on the market price. The equilibrium price of the currency is obtained where foreign currency demand is equal to supply. In the very short run, we assume that the demand for foreign currency is perfectly inelastic and increases in trade performance (either increase in exports or decrease in imports) lead to a shock in the foreign exchange market by increasing the supply. In this simple setting, such shock has a short term impact on the market such that the foreign currency depreciates. However, in the long run demand adjusts so that the equilibrium level of exchange rates is restored.

Consequently, this paper has two fundamental purposes: First, it will test the short run relationship between the real effective exchange rate of Chinese Yuan and the balance of trade. Then, it analyzes the causal relationship between these two variables of interest. The paper uses the Granger-causality test and the impact of exogenous variable on the exogenous variable is examined using Transfer Function methodology. In the next section, we present methodological considerations and the data. Then in the third section, we inspect the stationarity and look into Granger-causality tests. Section four shows the estimation results based on Transfer Function. Section five concludes.

2. Data

Maciejewski (1983) provides an extensive review of conceptual and methodological issues related to *effective exchange rate* (EER). He suggested that the EER is an appropriate indicator of international competitiveness and can easily be deflated by corresponding indices of relative prices to obtain the real indices. Chinn (2006) suggested that the most common technique to calculate the *real EER* (REER) is to weight the currencies by trade volumes. More formally, consider the following real effective exchange rate where $REER^j$ is the log real exchange rate relative to country ***j***.

$$REER_t = \sum_{j=1}^{n} w_j REER_t^j \tag{1}$$

The weights are based on bilateral trade volumes where third-market effects are captured through the following equations: w_j = (imports of *i* / Trade Volume of *i*) × (share of *i* imports from *j*) + (exports of *i* / Trade Volume of *i*) × (overall export weight) and overall export weight = β × (share of exports of *i* to *j* out of total *i* exports) + (1 − β) × (third market weight).

We used REER index provided by Bank for International Settlements (BIS). BIS publishes REER data since 1993 for 58 countries using manufacturing trade flows that is also a common practice in the literature. Spilimbergo and Vamvakidis (2003) suggest that it is likely that a fixed-weight index will misrepresent the impact of exchange-rate changes since trade flows change over time. The index provided by Bank for International Settlements (BIS) incorporates the changing trade patterns over time by using time-varying weights (Klau and Fung, 2006). The REER for China is available monthly in broad indices basket of BIS. The bank used the following selected trade weights to calculate the REER of Chinese Yuan: approximately 20% for US; 18% for Euro area; and 26% weight for Japan.[4] We used monthly REER in China from January 1994 to August 2009. An increase in REER indicates improved competiveness of Yuan in the international trade market. As shown in Panel 1.a, the real effective exchange rate seems to be a random walk process with an upward trend subject to formal testing. There is also an appreciation trend of the currency since the softening of the currency control in 2004.

Recent literature frequently used balance of trade (BOT) to examine trade performance. For example, Garcia-Herrero and Koivu (2009) used balance of trade, the difference between exports and imports, while Bahmani-Oskooee (1991 and 2010) used the ratio of exports to imports as the trade performance measure. Following the recent literature, we will use the difference between exports and imports as the measure of trade performance. The data of China's balance of trade (BOT) is obtained from National Bureau of Statistics of China. The values are in millions of current USD available monthly from January 1994 to August 2009. As shown in Panel 1.b, China's BOT (1994-2003) is generally positive with negligible variance until 2004, however since then the variance of BOT has elevated dramatically.

Imperfect substitutes model used in Rose (1990 and 1991) suggest that empirical trade balance analysis also includes the domestic and foreign income. We have included the Chinese and US GDP obtained from Chinese Statistic Institute and Bureau of Economic Analysis respectively. Both of these series are published quarterly so we have converted these series to monthly using linear interpolation.

3. Granger Causality Test

Before examining the causal relationship between the real effective exchange rate balance of trade, the time series properties of the individual variables were tested. Stationarity of the variables was investigated by the autocorrelation function (ACF), partial autocorrelation function (PACF) and augmented Dickey-Fuller test (ADF). Both ACF and PACF suggest that the series in levels show no indication of mean reversion.[5] Therefore, both of the principal series are tested for unit root using the ADF test. The ADF test is sensitive to the lag length; thus, the Akaike Information Criterion (AIC) and Bayesian information criterion (BIC) are used to determine the lag length of each variable. Twelve lags are selected for both variables as the optimal lag length. The existence of a unit root in each variable is tested using the following ADF model where dBOT and dREER indicates the first difference of BOT and REER respectively.

$$dbot_t = \alpha_0 + \gamma_1 bot_{t-1} + \alpha_1 dbot_{t-1} + \alpha_2 dbot_{t-12} + \varepsilon_{1t} \quad (2)$$
$$dreer_t = \beta_0 + \delta_1 reer_{t-1} + \beta_1 dreer_{t-1} + \beta_2 dreer_{t-12} + \varepsilon_{2t} \quad (3)$$

T-stats for the null hypothesis that γ_1 is equal to zero are low and the hypothesis cannot be rejected is only 2.146 and δ_1 is equal to zero is only 0.177. Hence, ADF test suggests that REER and BOT are not stationary at levels and they are both I(1) processes.[6] Thus, the differenced real effective exchange rate (dREER) and the differenced balance of trade (dBOT) are used in the remainder of this study. The time paths of dBOT and dREER are shown in Panel 2.a-b respectively.

Furthermore, we have examined the stationarity of Chinese and US GDP using the standard Augmented Dickey Fuller Tests as well. Chinese data indicates the existence of a unit root with strong seasonality. We first seasonally difference the data; then test the first differenced data for unit root. The test still indicates a non-stationarity with slow decay on ACF/PACF. Based on ADF, we differenced the series one more time to remove the unit root. ADF suggest second differenced Chinese GDP is an I(0) process with a t-test statistic of 4.70. US GDP series follow a similar pattern and required differencing to obtain a I(0) process.[7]

The next step is to examine the causality between dREER and dBOT, especially in the short run. Although there are several published pieces in the literature related to exchange rate and balance of trade, none of these articles have examined the short run causal relationship between these variables. In other words, the theoretical studies have led researchers to examine the unidirectional relationship such that exchange rate influence the balance of trade but a possible feedback from trade to exchange rate has been largely ignored. A plausible explanation for this type of feedback from BOT to REER is a trade surplus increases the foreign currency in the domestic economy that in return increases the value of the domestic currency in the short-run, as it's explained in the previous section.

In the empirical studies, Granger causality test has been repeatedly used to test whether or not the lagged and contemporaneous values of one variable can be used to predict the future values of another variable.[8] Based on the test, researcher is able to determine the direction of causality between two variables. The test uses the Vector Autoregression (VAR) method to reveal if the past and current values of one variable have a significant effect on the current value of another using a joint F-test. An F-statistic is calculated to see if the coefficients of one variable statistically different from zero. The null hypothesis is the variable of interest does not Granger-cause the dependent variable. If the test suggests a bi-directional causality then VAR method yields the most efficient standard errors. On the other hand, if the causality is unidirectional then VAR is over-parameterized and standard errors are not precisely estimated. The following system of equations is used testing the causality between the first differenced balance of trade (dBOT), real effective exchange rate (dREER), and GDP of US ($dGDP^{US}$); as well as second differenced GDP of China ($dGDP^{China}$). The estimating equations are as follows:

$$dBOT_t = \alpha_0 + \sum_{j=1}^{m} \alpha_i dBOT_{t-j} + \sum_{j=1}^{n} \alpha_j dREER_{t-j} + \sum_{j=1}^{y} \alpha_j dGDP^{US}{}_{t-j} + \sum_{j=1}^{x} \alpha_j ddGDP^{China}{}_{t-j} + \varepsilon_{1t} \quad (5)$$

$$dREER_t = \alpha_0 + \sum_{j=1}^{m} \alpha_i dREER_{t-j} + \sum_{j=1}^{n} \alpha_j dBOT_{t-j} + \sum_{j=1}^{y} \alpha_j dGDP^{US}{}_{t-j} + \sum_{j=1}^{x} \alpha_j ddGDP^{China}{}_{t-j} + \varepsilon_{2t} \quad (6)$$

$$dGDP^{US}{}_t = \alpha_0 + \sum_{j=1}^{m} \alpha_i dGDP^{US}{}_{t-j} + \sum_{j=1}^{n} \alpha_j dBOT_{t-j} + \sum_{j=1}^{y} \alpha_j dREER_{t-j} + \sum_{j=1}^{x} \alpha_j ddGDP^{China}{}_{t-j} + \varepsilon_{3t} \quad (7)$$

$$ddGDP^{China}{}_t = \alpha_0 + \sum_{j=1}^{m} \alpha_i ddGDP^{China}{}_{t-j} + \sum_{j=1}^{n} \alpha_j dBOT_{t-j} + \sum_{j=1}^{y} \alpha_j dREER_{t-j} + \sum_{j=1}^{x} \alpha_j dGDP^{US}{}_{t-j} + \varepsilon_{4t} \quad (8)$$

Since the results of Granger causality are quite sensitive to the lag length, Akaike Information Criterion (AIC) and Bayesian Criterion (BIC) are used to determine the optimal lags for each variable. In this study, the results of AIC and BIC tests both suggest 13 lags should be used for all the Granger causality tests.

The Granger Causality test results are given in Table 1. In the dBOT equation, the results indicate that the null hypothesis cannot be rejected, which means that the lagged values of dREER do not Granger cause a change in the current values of dBOT. However, in the dREER's equation, the calculated value of F-statistic is greater than the critical value in the test; hence, the lagged values of dBOT have an impact on the change in dREER. The results indicate that the null hypothesis can be rejected at the 8% significance level, which means that dBOT Granger causes a change dREER without any feedback. Therefore, dBOT is the exogenous variable, and dREER is an endogenous variable. The findings for the short-run are important. We found that in the short run, a change in the balance of trade causes a movement in the international competitiveness of Chinese Yuan but not vice versa. The short run unidirectional relationship supports the earlier proposition that increases trade performance lead to an increase in foreign currency domestically. Abundant foreign currency in return may contribute to the increase in the value of domestic currency in the short run. This finding compels for a transfer function estimation methodology to determine the short run impact of BOT on REER. However, neither the US nor the Chinese GDP has a significant impact on REER based on the granger causality test; hence they are excluded from the transfer function estimation, which will be presented in the next section.

4. Transfer Function Estimation

The Granger causality test is an important initial step to determine the structure of the model. The unidirectional causality between dBOT and dREER suggests a transfer function methodology to be employed since VAR methodology is over-parameterized and it estimates more coefficients than necessary. The equations of the transfer function methodology are as follows:

$$y_t = \alpha_0 + A(L)y_{t-1} + C(L)z_t + B(L)\varepsilon_t \quad (9)$$

$$D(L)z_t = E(L)\varepsilon_{zt} \quad (10)$$

where y_t is dREER, and z_t is dBOT. We have excluded the income in China and US since the granger causality test cannot reject the hypothesis that the lags of differenced Chinese and US GDP have no predictive power to explain the short run movements in real effective exchange rate. The only exogenous variable in the model is left is the differenced Balance of Trade (dBOT). C(L) represents the coefficients of the transfer function and shows the movement of the exogenous variable z_t (dBOT) affecting the time path of the endogenous variable y_t (dREER).

Transfer function estimation requires a five-step procedure. In the first step, the Box–Jenkins methodology is used to estimate the best fitting data-generating process for the exogenous variable, dBOT. The residuals (ε_{zt}) can be denoted as the filtered values of z_t, called the *"Filtered dBOT"*. The filtered dBOT series is considered as the pure innovations in the dBOT process. Based on the ACF and PACF graphs, and the results of AIC and BIC, the best fitting model for dBOT is ARMA(2,5). The time path of the *Filtered dBOT* is shown in Panel 3.a. The residual from this model is white noise.

In step two, the dREER series is filtered with the same methodology used in the dBOT series. *Filtered dREER* is obtained by applying the following filter:

$$y_{\mathrm{ft}} = y_t * [D(L)/E(L)] \tag{11}$$

The residual of the estimated model is a white noise process with no apparent autocorrelation. The time path of the *Filtered dREER* series is presented in Panel 3.b. Once the filtered dBOT and dREER are obtained, the cross-correlogram between dBOT and dREER is examined. The coefficients of the cross-correlaogram have a standard deviation of $(T\text{-}i)^{-0.5} = 0.072$ where T is the number of observations and i is the number of lags. The graph of the cross-correlogram is shown in Panel 4. The graph shows that there is a spike around the period 3 and 4, where the correlation coefficients are statistically different than zero at 95% confidence level.

The third step includes estimation several plausible transfer functions for y_t that is inferred from the cross-correlogram. These plausible models are shown in Table 3. In Model 1, we estimated the following specification:

$$y_t = a_0 + a_1 y_{t-1} + a_2 y_{t-2} + c_3 z_{t-3} + c_4 z_{t-4} + \varepsilon_t \tag{12}$$

The reason for choosing the delay factors of three and four months is due to the spikes in the cross-correlogram at the third and fourth lags. AIC and BIC are used to determine which plausible transfer function is the best fitting model for y_t. AIC/BIC for these models are given in the last column of Table 2. In Model 2, we have added the third lag for the dependent variable, which improved the fit of the model. In Model 3, we have dropped the constant that is insignificant in both Model 1 and Model 2. Model 3 has the lowest AIC and BIC, and all the coefficients of the parameters are statistically significant. The estimation result of the model 3 is as follows:

$$y_t = \frac{(0.0000966 z_{t-3} + 0.00010855 z_{t-4})}{(1 + 0.5037L^2 - 0.4856L^3 + 0.5095L^4)} + \varepsilon_t \quad (13)$$

Step four of the transfer function methodology is to examine whether the error term (ε_t) from the Model 3 is white noise. If the error term is a white noise, the transfer function procedure is complete, and the step five is unnecessary. However, the results suggest that there exists an autocorrelation in the error term of the estimated model, which is denoted as e_t. The residual from Model 3 is estimated as an ARMA process using standard Box-Jenkins method, the estimation of the error term from the best fitting model is as follows:

$$\varepsilon_t = 0.1569\varepsilon_{t-1} + (1 - 0.2596L^{12} - 0.2707L^{24})e_t \quad (14)$$

The fifth step is to combine the results from step three and four to estimate a full equation. A(L), B(L) and C(L) is estimated using standard Box-Jenkins method simultaneously. The Ljung-Box Q-statistics indicates that no significant autocorrelations in the error term ε_t of the estimated model. The coefficients of the parameters from the final estimation model are slightly different from the estimation results of model 3 and 4. The estimation result is shown in the following:

$$y_t = \frac{(0.0000444 z_{t-3} + 0.0000709 z_{t-4})}{(1 + 0.6315L^2 - 0.0645L^3 + 0.9528L^4)} + \frac{(1 - 0.2804L^{12} - 0.3286L^{24})\varepsilon_t}{(1 - 0.1379L)} \quad (15)$$

The results indicate that China's BOT have delayed short run effect on its real effective exchange rate. Moreover, the coefficients of the transfer function are relatively small but statistical significant and positive. Hence, there is a short run feedback from BOT to REER that is observed within 3-4 months of the shock. The feedback is positive suggesting that a favorable BOT shock in Chinese economy improves the competitiveness of the currency in the short-run.

5. Conclusion

This paper examines the short run causal relationship between real effective exchange rate and balance of trade in China. First, we tested the stationarity of these variables and found that both of the variables are I(1) processes, thus we used the first difference form of the variables. Then we examined the causality between effective exchange rate and balance of trade using Granger-Causality Test, which suggests that in the short run balance of trade causes a change in effective exchange rate but not vice versa. This is an important contribution of this paper since literature has not explored the short run causal relationship between these variables before. A plausible explanation for this type of feedback from BOT to REER is a trade surplus increases the foreign currency in the domestic economy that in return increases the value of the domestic currency in the short-run. The uni-directional relationship between exchange rate and balance of trade compels the use of transfer function methodology since Vector Autoregression estimation is over-parameterized. Transfer Function estimation shows that the balance of trade has a 3-4 month delayed effect on effective exchange rate in China. Moreover, the coefficients are positive suggesting that a positive trade performance shock leads to a favorable short run change in exchange rate in China.

One of the limitations of this study is the fact that Chinese economy has not been fully open until recently. Chinese government has had total control on the economy until late 1990s and has just loosened this control allowing the foreign investment and exchange rate to be mostly determined in the market economy. Still, the composition of the economy and the government controls in the past complicates the investigation about the exchange rate and international trade. Future research that incorporates the nonmarket forces into the current econometric modeling would be an interesting extension.

Endnotes

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1. See Drabek and Smith (1995) and Dornbush (1992) for trade liberalization related and Bahmani-Oskooee (2010), Chinn (2004) for trade performance related studies.
2. GDP data is based on World Development Database provided by the World Bank. Trade volume data is obtained from International Trade Statistics 2009 published by the World Trade Organization.
3. A recent report by Treasury suggests that Chinese Yuan is still undervalued as of June 2010. According to a CNN article, Chuck Grassley, R-Iowa called for a formal case against China through the World Trade Organization. (http://money.cnn.com/2010/07/08/news/economy/treasury_says_yuan_undervalued/)
4. The complete weighting matrix can be obtained from BIS website: http://www.bis.org/statistics/eer/index.htm
5. For brevity, ACF and PACF panels are excluded but available from the authors upon request.
6. The results of the ADF test below indicate that the first differenced BOT and REER are both stationary. For robustness check, we have tested the differenced variables for unit root. Both of these variables are difference stationary at the 1% significance level.
7. For brevity, we have excluded the ADF test results, but these tables are available from authors per request.
8. For these empirical studies, see Kholdy and Sohrabian (1990), Reuveny and Kang (1996), Enders et al. (1991) and Yaya (2009).

References

Bahmani-Oskooee, M. 1991. "Is There a Long-Run Relation between the Trade Balance and the Real Effective Exchange Rate of LDCs?" *Economics Letters*, 36, 403-407.

Bahmani-Oskooee, M. 2010. "Nominal and Real Effective Exchange Rates of Middle Eastern Countries and Their Trade Performance," *Applied Economics*, 33, 103-111.

Black, S.W. 1976. "Multilateral and Bilateral Measures of Effective Exchange Rates in a World Model of Traded Goods," *Journal of Political Economy*, 84, 615–622.

Brada, J. C., Kutan, A. M. and Zhou, S. 1993. "China's Exchange Rate and the Balance of Trade," *Economic Change and Restructuring,* 26, 229-42.

Chinn, M. D. 2006. "A Primer on Real Effective Exchange Rates: Determinants, Overvaluation, Trade Flows and Competitive Devaluation," *Open Economies Review,* 17, 115–143.

Chinn, M. D. 2004. "Incomes, Exchange Rates and the U.S. Trade Deficit, Once Again," *International Finance*, 7, 1–19.

Dornbusch, R. 1992. "The Case for Trade Liberalization in Developing Countries," *The Journal of Economic Perspectives,* 6, 69-85.

Drábek, Z. and Smith, A. 1995. "Trade Performance and Trade Policy in Central and Eastern Europe," *CEPR Discussion Papers 1182*, C.E.P.R. Discussion Papers.

Enders, W. and Sandler, T. 1991. "Causality between International Terrorism and Tourism: The Case of Spain," *Studies in Conflict and Terrorism,* 14, 49–58.

Garcia-Herrero, A. and Koivu, T. 2009. "China's Exchange Rate Policy and Asian Trade," *BIS Working Papers,* No.282.

Kenen, P. B. and Rodrik, D. 1986. "Measuring and Analyzing the Effects of Short-Term Volatility in Real Exchange Rates," *The Review of Economics and Statistics*, 68, 311-315.

Kholdy, S. and Sohrabian, A. 1990. "Exchange Rates and Prices: Evidence from Granger Causality Tests," *Journal of Post Keynesian Economics,* 13, 71-78.

Klau, M. and Fung, S. S. 2006. "The New BIS Effective Exchange Rate Indices," *BIS Quarterly Review*, March 2006.

Liew, K., Lim, K. and Hussain, H. 2003. "Exchange Rate and Trade Balance Relationship: The Experience of ASEAN Countries," *International Trade* 0307003, EconWPA.

Maciejewski, E. 1983. "'Real' Effective Exchange Rate Indices: A Re-Examination of the Major Conceptual and Methodological Issues," *IMF Staff Papers,* 30, 491–541.

Maeso-Fernandez, F., Osbat, C. and Schnatz, B. 2002. "Determinants of the Euro Real Effective Exchange Rate: A BEER/PEER Approach," *Australian Economic Papers,* 41, 437–461.

Reuveny, R. and Kang, H. 1996. "International Trade, Political Conflict/Cooperation, and Granger Causality," *American Journal of Political Science*, 40, 943-970.

Rose, A.K. 1990. "Exchange Rates and the Trade Balance: Some Evidence from Developing Countries," *Economic Letters*, 34: 271-275.

Rose, A. K. 1991. "The Role of Exchange Rates in a Popular Model of International Trade: Does the 'Marshall–Lerner' Condition Hold?" *Journal of International Economics,* 30, 301-316.

Spilimbergo, A. and Vamvakidis, A. 2003. "Real Effective Exchange Rate and the Constant Elasticity of Substitution Assumption," *Journal of International Economics,* 60, 337–354.

Turner, P. and Van't dack, J. 1993. "Measuring International Price and Cost Competitiveness," *BIS Economic Papers,* No.39.

Yaya, M. E. 2009. "Terrorism and Tourism: The Case of Turkey," *Defence and Peace Economics*, 20, 477-497.

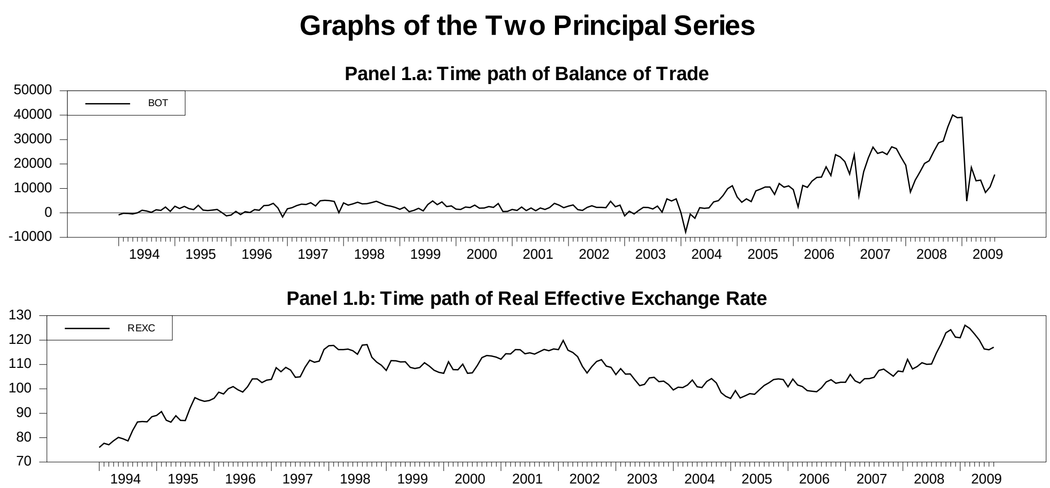
Table 1: Granger Causality Test

Dependent Variable: DBOT			Dependent Variable: DLGDPUS		
Variable	F-Statistic	Signif	Variable	F-Statistic	Signif
DBOT	5.3876	0.0000	DBOT	0.8879	0.5678
DREXC	1.2042	0.2859	DREXC	1.2895	0.2300
DLGDPUS	1.0672	0.3949	DLGDPUS	61.4291	0.0000
DDLGDPCH	2.5648	0.0039	DDLGDPCH	1.5535	0.1099
Dependent Variable: DREXC			**Dependent Variable: DDLGDPUS**		
Variable	F-Statistic	Signif	Variable	F-Statistic	Signif
DBOT	1.6450	0.0836	DBOT	1.8428	0.0451
DREXC	3.9134	0.0000	DREXC	0.7304	0.7299
DLGDPUS	1.4986	0.1290	DLGDPUS	0.8823	0.5735
DDLGDPCH	1.2224	0.2732	DDLGDPCH	7.6777	0.0000

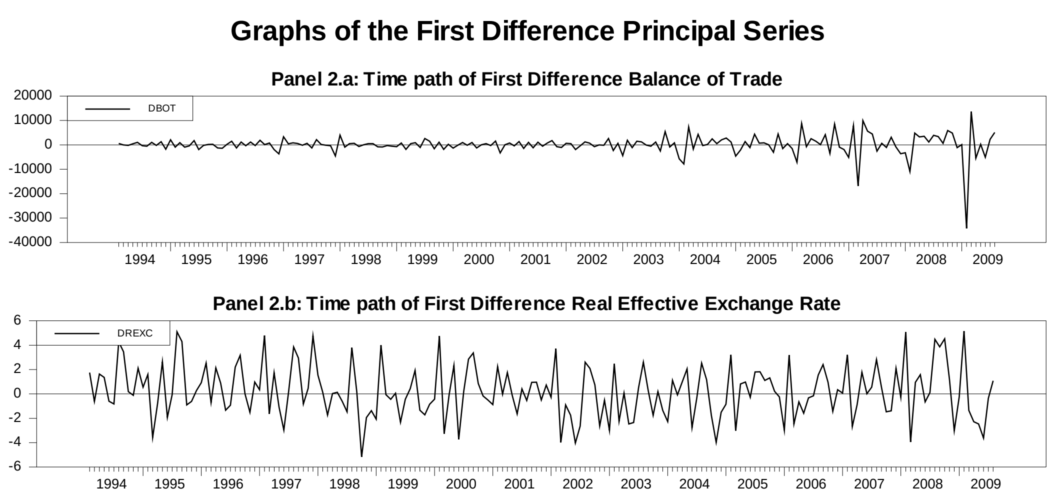
Table 2: Plausible Transfer Function Models

	a1	**a2**	**a3**	**a4**	**c3**	**c4**	**AIC/BIC**
Model 1	-0.2273 [-0.805]	-0.2255 [-0.797]	0.7665 [2.694]		0.00003079 [2.268]	0.000030878 [3.364]	1214.898/ 1230.946
Model 2	0.2725 [1.563]	-0.4484 [-4.100]	0.5475 [4.923]	-0.7248 [-3.960]	0.00003174 [3.544]	0.000100817 [2.907]	1211.306/ 1230.563
Model 3		-0.5037 [-2.757]	0.4856 [2.685]	-0.5095 [-2.784]	0.00009660 [3.250]	0.00010855 [3.372]	1211.146/ 1227.194

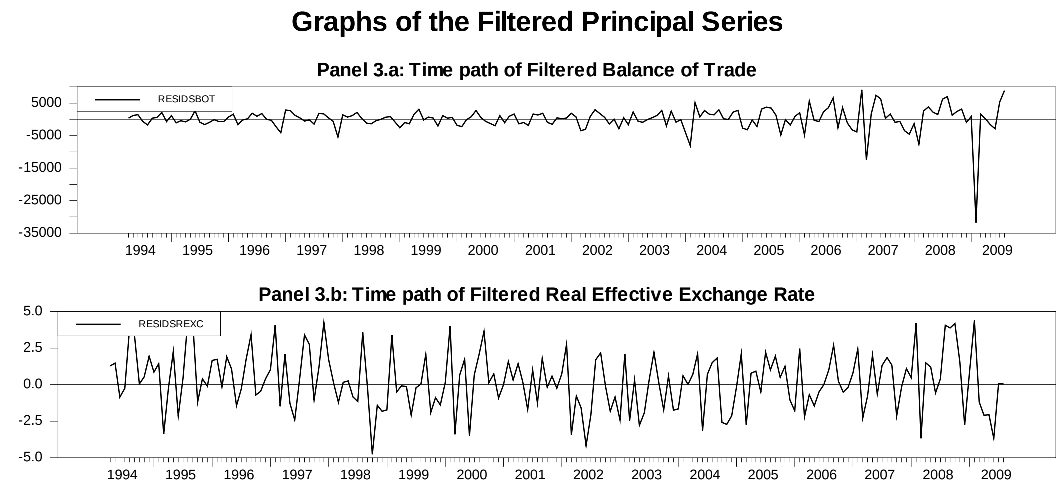
Panel 1.a-b



Panel 2.a-b



Panel 3.a-b



Panel 4