Exchange Rate Behaviour after Recent Float: The Experience of Pakistan

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I. INTRODUCTION

Exchange rate is a price of traded goods in the world market. To maintain the commodities competitive in the market, exchange rate should be adjusted according to the change in prices. If it is adjusted accordingly, then we say that purchasing power parity (PPP) holds in that country. However, phenomenon of PPP is completely kicked out under floating exchange rate in the short run. Recent statement by the President National Bank of Pakistan, Syed Ali Raza that the exchange rate and the interest rate are two faces of the same coin shows the changes in the exchange rate is strongly associated with the changes in real interest rate differential[1] (Bokhari, 2004). Moreover, it is also argued that under free float the value of currency is determined by demand and supply of foreign exchange and to control the value of currency using open market operations interest rate is used as the key monetary policy tool. Deterioration of trade balance leads to deprecation in exchange to make the exports competitive in the market and appreciation vice versa.

Pakistan had adopted free floating exchange rate since 17 July 2000. It is evident that initially moving from fixed or managed float exchange rate system to free float exchange rate system the volatility of nominal exchange rate increases dramatically but usually other economic fundamentals remain the same. Theoretically, free float exchange rate eliminates the imbalances in balance of payments through automatic changes in exchange rate[2]. However, in Pakistan, the market conditions and transmission mechanism are imperfect and just changes in exchange rate do not eliminate the imbalances in current account balance and some other fiscal and monetary measures are used to fix these imbalances[3].

In early days of free float the exchange rate depreciated heavily at one and a half percent each month till September 11 (9/11) happened and it started appreciating after that. It is also observed the three months before the 9/11 the exchange remained stable and the main reason of this stability was the increase in foreign exchange (FOREX) reserves above the 2 Billion Dollars mark. However, it is usually noticed that after the September 11 event exchange rate appreciates against dollar but depreciates against other currencies. Initially discount rate (twice) and cash reserve requirement are used to contain depreciation of the Rupee (Janjua, 2003). These tools are mainly used before September 11, 2001 and after that sterilization operations were used to contain excess appreciation and inflation[4].

Fear of future depreciation creates an atmosphere of speculative attack on the home currency due to slowing down the pace of foreign exchange sale and rapid issuance of letters of credit by importers to take maximum benefits and vice versa if fear of future

[1] This phenomenon is known as uncovered interest parity

[2] The imbalances in balance of payments can be eliminated through inflows and outflows of capital which keeps exchange rate stable. However, in Pakistan capital flows has not been liberlised so the transmission mechanism is not perfect to fix these imbalances.

[3] Stability of exchange rate is also a major concern which is usually maintained by intervening in the foreign exchange market.

[4] In this pre 9/11 after floating regime, various restrictions were imposed on various transactions which are mainly related to the capital outflows. This shows that Pakistan did have strict capital controls, which is good to prevent the possibility of currency crisis as proven by the experience of Malaysia in the South East Asian financial crisis.

appreciation is expected. Currency depreciation may result in capital flight from stock market, which may cause currency crisis like East Asian countries in 1997. However, the possibility of currency crisis may arise under the most adverse circumstances such as: weak economic fundamentals, sudden stoppage of inflows, depreciation of currency by major trading partners, sharp decline in exports etc.

The objective of the paper is to check the movements of exchange rate with prices, interest rate, forex reserves and trade balance. The validity of PPP hypothesis is also checked which does not hold under floating exchange rates in the short run. However, UIP holds because interest rate is used as a monetary tool and exchange rate adjusts accordingly. Moreover, demand and supply of foreign exchange determines the exchange rate in the market and recent inflow of foreign exchange appreciates the currency against the dollar. Deterioration of trade balance leads to exchange rate depreciation so that the margin between the exports and the imports is minimised and the equilibrium is restored. Therefore, movements of exchange rate with respect to movements in exports and imports are also checked.

Organisation of the study is as follows; Section II discusses the theoretical aspects and reviews the past studies briefly. Section III explains the data issues, Section IV describes the methodology used for the estimation. Section V gives insights on the past behaviour of the variables, Section VI explains the empirical findings and Section VII draws some important conclusions.

II. Theoretical Aspects

Exchange rate is a price of domestic goods in the foreign market and is adjusted through the mechanism of change in prices. However, the adjustment behaviour of exchange rate is differs by regime. Under floating exchange rate the exchange rate is adjusted in market through supply and demand of foreign exchange. But under managed float and crawling peg is adjusted usually according to change in prices of both home and foreign country. Interest rate is used as the main monetary tool to adjust the exchange rate under flexible exchange rate system. Moreover, overvalued and undervalued exchange rate creates problems for exporters and importers which results in deterioration and improvement in trade balance respectively. We discuss these features briefly in the following sub-sections.

II.1. Purchasing Power Parity

The relationship between exchange rate and prices can be explained by the phenomenon of purchasing power parity developed by Cassel in 1916. This phenomenon states that assuming no transaction costs such as transport and tariffs between the two countries the law of one price applies to all goods and services consumed. Simply stated, the PPP holds if the price level in the country is equal to the product of the price level in the other and the nominal exchange rate between their currencies; this is known as absolute version of PPP. In that case the real exchange rate remains constant. In practice, price indices are used as a proxy for prices in the home and foreign country. However, it is argued that the weights used in compiling the price indices of the two countries are not identical. Therefore we cannot check the PPP between two countries in a very authentic way. Another phenomenon known as relative PPP, which states that country's inflation

rate can only be higher than another's to the extent that its exchange rate depreciates. Relative PPP holds if absolute PPP holds period by period.

Casellian believes that real exchange rate is mean reverting, which implies that PPP holds continuously. The Casellian version of PPP is represented as $q_t = \rho q_{t-1} + \alpha + \varepsilon_t$ $\left(\text{where } 0 < \rho < 1, \textit{and } q \textit{ represents real exchange rate}\right)$. If ρ <1 then a current disturbance in nominal exchange rate – relative price configuration due to some liquidity effect does not show mean reverting behaviour. If ρ=1 the exchange rate is a random walk. Recent work has been done using cointegration technique using nominal exchange rate and domestic and foreign prices, i.e., $s_t = \beta + \alpha_0 P_t + \alpha_1 P_t^* + \vartheta_t$ (s represents nominal exchange rate, p represents prices and * represents foreign country, variables are in log form). If all variables are integrated of order one then we can say that weak PPP holds, while if α_0=1 and α_1=-1 then strong version of PPP holds. The later formulation of PPP model is based on law of one price allowing for transportation costs, trade impediments, product differentiation and presence of non-traded goods (Moosa and Bhatti, 1997a)

II.2. Uncovered Interest Parity

Interest rate and exchange rate are linked with the international parity conditions. If the bonds of two countries (in local currency) have similar risk and maturity, the difference between the interest rates attached to them in both countries can be explained by the uncovered interest parity (UIP), which can be represented as $\dot{s} = r - r^*$ (where $\dot{s}$ represents depreciation/appreciation of real exchange rate, r represents domestic interest rate, and r^* represents foreign interest rate).

II.3. Monetary Model of Exchange Rate Determination

The Flexible-Price Monetary Model (FPMM)[5] developed by Frenkel (1976), Mussa (1976) and Bilson (1978) is based on the assumption that prices are flexible and changes in the nominal interest rate reflect the changes in expected inflation rate and demand for the domestic currency falls relative to the foreign currency leading to instant depreciation and the relationship between the exchange rate movements and differential in the nominal interest rates is positive. Due to flexible nature of prices, the PPP holds continuously. According to this theory, there is one to one relationship between exchange rate movements and money differential. It also shows that increase in national income results in appreciation of exchange rate, through increase in the transaction demand for money, holding interest rate and money supply constant, which results in fall in price level. A rise in domestic national interest rate[6] leads to decline in the demand for money and an increase in the expenditures on goods, which results in an increase in the domestic prices and that leads to exchange rate depreciation.

Mundell – Flemming (M-F) model is a sticky price model which assumed that the prices are given, the expectations are static, capital is less than perfectly mobile, and PPP does not hold continuously. According to this model, given prices fixed with a flat AS curve, increase in money supply leads to increase in real money balances and decline in

[5] It is also known as "Chicago theory"

[6] Real interest rate=nominal interest rate + inflation expectations

interest rate. At lower interest rate the net capital inflows declines and current account balance deteriorates. This result in the depreciation of exchange rate leads to decline in prices of home goods and shifts back the interest rate to its initial value.

Copeland (1994), Muslehuddin (2001) and various other authors criticized the negligibility of expectations and fixation of prices. Muslehuddin (2001) further argued that according to M-F model ride in interest rate leads to continuous flow of capital which is very unrealistic because investors do rearrange the stocks after certain time. The main criticism on the FPMM is the assumption of PPP that does not hold continuously under flexible exchange rate especially. Dornbusch (1976) proposed a model of Sticky-Price Monetarist Model (SPMM) that explains large and prolonged departures from PPP. The basis of the model is that prices and wages are determined in sticky-price markets and change only slowly over time in response to various shocks (Frankel, 1979). According to Dornbusch (1976) an increase in money supply in the short run decreases the interest rate resulting in capital outflows and depreciation of the real exchange rate, which implies negative relationship between exchange rate and interest rate[7].

Frankel (1979) modified the Dornbusch (1976) model by taking inflation expectation into account. Frankel model is also SPMM model and believes that PPP only holds in the long run. It is also assumed that UIP holds and that expected rate of depreciation of the exchange rate is a positive function of the gap between the spot and average long run exchange rate and the expected long run inflation differential between home and foreign country. Irrespective of the small criticisms by Frankel, both models are more or less are the same model, therefore in this paper we'll use a joint term for these model, i.e. Dorenbuch – Frankel (D-F) model.

SPMM generally exhibit classical properties in the long run but allow for temporary goods-market disequilibrium in response to real and monetary shocks that are less than perfectly anticipated (Obstfeld and Rogoff (1984)). The main element in these models is the mechanism that how domestic goods prices adjust over time in response both to current disequilibrium and to expectations of future events. Sarno and Taylor (2002) stated that the currencies of countries with relatively higher interest rates over long run are expected to depreciate. The initial interest rate rises induce a sharp exchange rate appreciation followed by a slow depreciation as prices adjust, and this process continues until long run PPP is achieved.

Several other studies have done on exchange rate behaviour using annual, quarterly and monthly data on various countries to check the validity of PPP, UIP and the three monetary models, i.e., FPMM, D-F model and M-F model. Using annual data from 1971 – 2000 Alam, Butt and Iqbal (2001) concluded for 10 Asian countries including Pakistan that UIP holds continuously[8]. Afridi and Siddiqui (1993) gave the framework of

[7] Dornbusch model assumed a small country which faces a given world interest rate and capital mobility. The other assumptions include: UIP holds, world prices for imports are given in the goods market and the domestic output is an imperfect substitute for imports. The major difference between FPMM and this model is that the former assumed that PPP holds continuously, while this model assumes that PPP holds only in the long-run because of sticky nature of prices in the short run.

[8] In most of the Asian countries the assumption of perfect capital mobility did not hold in the period which was taken for the analysis[8]. Moreover, almost in all the developing countries which are taken, the free float exchange rate regime was adopted in the late nineties or even in 2000[8]. Evidence of cointegration based on 30 annual observations could be misleading because the sample size should be large enough so that one can use generous number of lags to avoid specification error and making the model more reliable.

the determination of real exchange rate. After that Afridi (1995) using the same framework found that real exchange rate is explained by capital flows, excess domestic credit, openness and government consumption pf non-tradable GDP but is not explained by terms of trade, investment, technological change. Furthermore he also found that lagged dependent variable and nominal devaluation are highly significant in explaining the movements in real exchange rate. Bhatti (2001) test the empirical validity of the traditional flow model (M-F model) of exchange rate and concludes that Pak Rupees is determined against the six industrial nations by differences in prices, income and interest rate differential. Bhatti (1997b) focused on ex ante PPP and concluded that real exchange rate is a random walk and nominal exchange rate is determined by relative prices as well as expected real exchange rate. Choudhri and Khan (2002) found no evidence of a significant pass through of rupee depreciations to consumer prices in the short-run. This finding is consistent with recent theoretical analysis that suggests a weak short-run association between exchange rate changes and inflation.

There is lots of criticism on the validity of PPP, e.g., Rogoff (1999) stated that shocks to PPP tend to dampen out over the long run and in linear models, Mark and Choi (1997) concluded that there is a need to go beyond PPP to understand the evaluation for real exchange rates, Macdonald (1999) found the departure behaviour of exchange rate from PPP etc. MacDonald (1999) argued that in the long run the PPP does hold but the speed of adjustment is very slow as previous believers think that it holds continuously. Obstfeld and Taylor (1997) show that the adjustment speed is as low as 12 months for aggregate CPI based real exchange rate. However, Macdonald (1999) argued that the 12 months is the Cassel's suggested course of time that the currencies should revert to PPP.

Macdonald (1999) argued that due to presence of transactions costs, deviations from PPP should follow a non-linear mean reverting process and the speed of mean reversion entirely depends on the deviations from PPP[9]. Coleman (1995), O'Connel (1998), Obstfeld and Taylor (1997) and Michael *etal* (1997) estimated the non-linear models of PPP but non-linear adjustments are not very helpful to a policy maker who needs long run exchange rate for assessment purposes.

Meese and Rogoff (1988) did not find strong correspondence between exchange rates and interest differential. Baxter (1994) concluded that real interest differential is related only to temporary components of real exchange rate and the link between real ER and real interest differentials is very weak. Meese and Rogoff (1988) concluded that RW model of exchange rate is the best for forecasting among other models of exchange rate determination. However, MacDonald (1999) concluded that fundamentals have clear role in the determining in-sample and out-of-sample performance of exchange rate models and Meese and Rogoff hypothesis of forecasting the random walk model of exchange rate does not exist and he supported the view that exchange rates are predictable at horizons as short as one moth ahead. Kemal (2004a) concluded for UK exchange rate that after adoption of inflation targeting regime (interest rate is the key monetary tool to control inflation in inflation targeting regime which both directly and indirectly affects the

[9] The deviations from PPP could be due to several reasons such as nominal exchange rate overshooting due to stickiness of prices in the short run or real disturbances which drives real exchange rate. In the first case nominal exchange rate drive volatility in real exchange rate, while in the later case real exchange rate drives nominal exchange rate volatility.

exchange rate) real exchange rate is not completely a random walk, it is affected by the short run changes in the short term real interest differential. Kim (1997) found that dominant role of real shocks in the bilateral exchange rates.

II.4. Adjustment in Exchange Rate due to Changes in Trade Balance

Exchange rate is also adjusted due to improvements and deterioration of trade balance. Depreciation in exchange rate due to deterioration in trade balance makes domestic goods cheaper in foreign market, which helps in boosting exports and decline in imports. On the other hand improvement in trade balance leads to exchanger ate appreciation makes the domestic good expensive in the world market, which deteriorates the trade balance due to decline in exports and increase in imports. This result has also been shown by Kemal (2004b) that exchange rate is adjusted due to change in trade balance. Furthermore he also concluded that exchange rate is also adjusted due to temporary shocks in exchange rate. Bokhari (2004) also stated that the pressure on the Rupee can be explained by the soaring trade deficits.

II.5. Adjustment in Exchange Rate due to Changes in FOREX Reserves

Exchange rate is adjusted due to changes in FOREX reserves. In the recent past it has been observed that due to inflow of foreign exchange the Rupee highly appreciated against Dollar. A significant negative relationship between exchange rate and foreign exchange reserves has been observed in case of Pakistan in the study by Kemal (2003). A decline in foreign exchange reserves leads to depreciation in the open market exchange rates. It also results in an increase in exchange rate differential between open and official exchange rates. This exerts pressure on State Bank to devalue the exchange rate. It is also concluded that whenever reserves fall below the psychological barrier i.e. one billion dollar, there is a sort of panic in the foreign exchange market. Open market exchange rate starts depreciating and the gap between official and open market exchange rate starts widening. This forces the State bank to devalue the currency sometimes under the pressure from IMF; one of the conditionalities to provide more reserves by IMF is to devalue the currency. Soon after the devaluation IMF releases the money and thus boosting the reserve position. Instantaneous adjustment in reserves following devaluation is also observed. The other main reason for the instantaneous adjustment after devaluation is its impact on the expectations regarding future devaluation, which reduces the demand to hold dollars. Remittances start rising and the mal-practices in the trade such as under- and over invoicing stop.

III. Data

Monthly data has been taken on nominal exchange rate, interest rate (government bond yield and in some cases money market rate), money supply (money, Quasi money, and in some cases direct M2), consumer price index (CPI) which are used as prices, exports, imports, and foreign exchange (FOREX) reserves from the International Financial Statistics CD-Rom from July 20000 to August 2004 for Pakistan, USA, UK, Euro Area and Japan. For each country our total sample size is 49. We are analyzing the behaviour of exchange rate since we adopted flexible exchange rate. The nominal

exchange rate started appreciating in post 9/11 while it was depreciating before that, therefore the comparison between these two phases has also been done in Section V.

III.1. Construction of Variables

Data on nominal exchange rates for all the four countries is available in terms of US Dollar. These were then converted in terms of Rupee against other currencies, i.e., Sterling, Euro and Yen. Government bond yield and in some cases money market rate is taken as interest rate variable. Money supply variable is calculated by adding money and quasi money where direct data on M2 is not available. Consumer price index (CPI) has been taken as price variable for both domestic and foreign prices. Exports and imports are taken in terms of Pakistan Rupees and then converted to Dollars by dividing with exchange rate. We do not have readily available data on the real exchange rates, nominal interest differential, nominal money differential, trade balance, real interest differentials, and the real money differentials and we constructed it as follows,

$$RER = \frac{ER * CPI^{*}}{CPI} \quad (1)$$

$$NID = I - I^{*} \quad (2)$$

$$RID = R - R^{*} \quad (3)$$

$$R = I - \pi \quad (4)$$

$$\pi = \frac{CPI_{t} - CPI_{t-1}}{CPI_{t-1}} \quad (5)$$

$$NMD = MI - MI^{*} \quad (6)$$

$$RMD = RMI - RMI^{*} \quad (7)$$

RER represents real exchange rate, *ER* represents nominal exchange rate, *CPI* represents consumer price index, which is used as prices and * represents for the foreign country. NID represents nominal interest differential, I represents nominal interest rate and superscript * represents foreign country. RID represents real interest differential, π represents inflation rate, NMD represents nominal money differential and RMD represents real money differential. MI and RMI represent nominal money index and real money index respectively which are calculated using base July 2000.

IV. Methodology

Our primary objective is to check the behaviour of exchange rate after recent float. Due to small sample size (49) we did not use cointegration analysis[10]. However, short-run linkages of exchange rate with other variables are checked using Structural Vector Autoregressive (SVAR) approach. SVAR model is used by taking the log first difference of all the variables because if the variables are integrated of order one then one should estimate VAR using first difference rather using levels (Maddala and Kim, 1998).

A stochastic process is said to be stationary if it series exhibit mean reversion and fluctuates around constant long run mean, the variance of series is constant, and the value of auto-covariance between two-time periods depends on the distance or lag between the

[10] Toda (1994) argued that even 100 observations are insufficient to detect the correct cointegrating rank if stationary root is higher than 0.8. Podivinsky (1990) argued that tests to check Johansen cointegration may be inappropriate when applied to sample size less than 100.

two time periods and not on the actual time at which the covariance is computed. The other conditions that need to be satisfied for series to be stationary include initial condition is not given, no major random shock takes place, and the sample size is quite large[11].

For testing stationarity of the data Augmented Dickey-Fuller (ADF) test and Philip-Perron (PP) test are generally employed. Though there are several shortcomings in using these tests (Madalla and Kim, 1998) but still these two tests are the most commonly used and we do the same. PP test is useful when there are structural breaks in the data otherwise ADF and PP give the same result. We employed both ADF and PP tests because exchange rate behaves differently in pre and post 9/11. AIC and SBC criteria are used to check for proper lag lengths[12].

IV.1. Structural VAR

VAR approach first developed by Sims in 1980 based on the invalidity of the simultaneous equation models which used restrictions to identify structural forms. However, VAR approach is totally an atheoretical approach, which relies on the previous information of the variables. Simple VAR can be expressed as $y_t = A(L)y_{t-1} + w_t$, while structural VAR take a form as $y_t = A_0 + A(L)y_{t-1} + w_t$. VAR approach is really useful to check the dynamic behaviour of economic variables and also provides some interesting insights and appears to bring certain benefits for forecasting (Greene, 2003). Though there are some disadvantages of the approach but in doing time series analysis advantages of this approach are much more than disadvantages[13].

IV.2. Impulse Response Function

Impulse response function (IRF) shows the time of adjustment paths in response to the shock caused by either other variables or by any exogenous shock. IRFs are the useful tool for characterising the dynamic responses implies by estimated VARs. Moreover, IRF tells us the consequence of the shock when it appears in some variable, e.g., due to oil price shock there is a fear of increase in domestic prices, therefore, what would be the policy. Is there adjustment in interest rate to maintain the price level or exchange rate adjust to avoid unnecessary depreciation. It also tells us that whether equilibrium is restored by that variable which is hit by certain shock or it continues hurting it (Details are given in Appendix).

V. Descriptive Analysis

Volatility in prices measured by coefficient of variation is given in Table 1. Prices in Pakistan remained more stable in pre 9/11 than post 9/11. The main reason of high volatility in post 9/11 could be the recent increase in oil prices. From the Table 1 it is evident that inflation in USA, UK, and Euro area was more or less of the same variation

[11] A series is said to be stationary if the series exhibits mean reversion and fluctuate around the long run equilibrium value, it has constant, finite, and time invariant variance, and has a correlogram that diminishes as lag length increases (Enders, 1995).
[12] Details of ADF and PP tests and AIC and SBC are given in Appendix
[13] Some of the advantages and disadvantages are given in the Appendix

however, if we compare it between the two periods then the inflation was higher in post 9/11. Japan's inflation was quite stable over the two periods, though the oil price hike did impact it as well. On the other hand, variation in relative prices was very stable in pre 9/11, while, little high in post 9/11. In comparison volatility in relative prices between Pakistan and Japan was more volatile than the other three.

Table 1
Volatility in Prices (CPI)

	Overall	Pre	Post
Pakistan	4.34	0.97	3.6
USA	2.55	1.16	1.99
UK	2.74	0.81	2.33
Euro	2.53	0.91	1.78
Japan	0.73	0.32	0.34

Variations in Pak Rupee nominal exchange rate against dollar were slightly higher in pre 9/11 than post 9/11, while, variability of nominal exchange rate against Sterling, Euro and Yen was more stable in pre 9/11 and it became more volatile in post 9/11 as shown in Table 2. Opposite to the movements of nominal exchange rate, volatility in real exchange rate against all the four currencies was higher in post 9/11 than pre 9/11. It is also evident that volatility in nominal exchange rate was higher than the real exchange rate except for Rupee per Dollar.

Table 2
Volatility in exchange Rate

	Nominal Exchange Rate			Real Exchange Rate		
	Overall	**Pre 9/11**	**Post 9/11**	**Overall**	**Pre 9/11**	**Post 9/11**
Dollar	4.22	2.43	2.22	5.27	2.5	3.51
Sterling	7.78	4.56	6.8	6.41	4.39	5.61
Euro	12.08	1.98	10.33	10.5	1.92	8.93
Japan	5.14	0.0001	5.39	6.22	0.0001	3.38

Table 4 shows the correlation between the relative prices of Pakistan against the other currencies. It is found that the correlation between the relative prices of Pak – UK and Pak – Euro was the maximum and minimum between US – Japan. It has also been found that correlation between the relative prices was higher in post 9/11 except for US-Japan which remains same in the two periods.

Table 4 shows that correlation between relative prices and nominal exchange rate is not very strong which shows the departure from the PPP hypothesis. However, the correlation is still better in case of UK and Euro but after looking at the other half of the table the correlation between the change in relative prices and change in nominal exchange rate highly insignificant and very small, which implies that changes in relative prices and changes in exchange rate has very weak link or in other words we can say that short run movements between the two are not very significant and in short run PPP does not hold.

Table 3
Correlation between the Relative Prices

Variables	Overall	Pre	Post
US-UK	0.83	0.76	0.85
US-Euro	0.84	0.79	0.86
US-Japan	0.80	0.80	0.79
UK-Euro	0.92	0.90	0.92
UK-Japan	0.85	0.69	0.91
Euro-Japan	0.84	0.69	0.88

Table 4
Correlation between Relative Prices and Nominal Exchange Rate

	Relative Prices and Nominal Exchange Rate			***Change in Relative Prices and Nominal Exchange Rate***		
	Overall	Pre	Post	Overall	Pre	Post
Pak – US	0.35	0.32	0.55	0.12	0.0004	0.19
Pak – UK	0.81	0.30	0.80	0.16	0.11	0.18
Pak – Euro	0.81	0.31	0.76	0.04	-0.22	0.16
Pak – Japan	0.25	0.52	0.79	0.01	0.04	-0.02

Table 5 shows that correlation between nominal and real exchange rate was higher in pre 9/11 than post 9/11 and the similar picture is depicted from the other half of the table that the correlation between changes in nominal exchange rate and changes in real exchange rate was higher in pre 9/11[14]. This implies that changes in both the variables are linked with each other, however, we can check the interlinkages through VAR structure which we did not check in this study and can be part of future research.

Table 5
Correlation between Nominal and Real Exchange Rate

	Real and Nominal Exchange Rate			***Change in Real and Nominal Exchange Rate***		
	Overall	Pre	Post	Overall	Pre	Post
Pak – US	0.940	0.996	0.91	0.960	0.984	0.984
Pak – UK	0.990	0.996	0.99	0.983	0.989	0.989
Pak – Euro	0.990	0.997	0.99	0.988	0.994	0.994
Pak – Japan	0.610	0.91	0.64	0.985	0.991	0.991

Table 6 shows some more interesting results that correlation between relative prices and real exchange rate is negative for Pak – US for both pre 9/11, post 9/11 and overall and Pak – Japan overall. However, it is positive for other two currencies. This

[14] The correlation between changes in nominal and real exchange rate of Japan was quite higher than the correlation between the two in the level form.

shows that changes in real exchange rate are not highly correlated with the changes in relative prices as PPP hypothesis stated.

Table 6
Correlation between Relative Prices and Real exchange rate

	Relative Prices and Real Exchange Rate			***Change in Relative Prices and Real Exchange Rate***		
	Overall	Pre	Post	Overall	Pre	Post
Pak – US	-0.64	-0.40	-0.84	0.39	0.18	0.70
Pak – UK	0.70	0.21	0.68	0.16	0.25	0.38
Pak – Euro	0.73	0.23	0.66	0.04	-0.12	0.34
Pak – Japan	-0.60	0.16	0.06	0.01	0.17	0.18

Table 7 shows growth rates of prices, relative prices, and nominal and real exchange rate overall and for both pre and post 9/11. Prices in Pakistan grew at higher rate than the other four countries. Inflation was higher in post 9/11 than pre 9/11. Japan has experienced negative inflation over the entire period, both in pre and post 9/11. Overall inflation in USA and UK were same and higher than the Euro Area. However, USA inflation was higher in pre 9/11, while UK and Euro Area inflation was lower in pre 9/11 than post 9/11.

Value of Rupee – Dollar was lower at the starting period and now it is higher. However, the trend growth rate shows 0.06 percent per month appreciation rate over the entire period. Pre 9/11 period is a phase of depreciation of Pak Rupee against US Dollar, while huge appreciation was recorded in Pak Rupee exchange rate against US Dollar. However, growth rate of Pak Rupee Exchange rate against Sterling, Euro, and Yen showed that in both pre and post 9/11 era the exchange rate depreciated against these currencies. The depreciation rate is higher in the pre 9/11 era against Sterling and Euro, while the trend growth is same in both periods against Japanese Yen.

Relative prices against all currencies have upward trend. However, in pre 9/11 era the relative pieces of Pakistan and USA had downward trend. It is very interesting to note that growth rate of relative prices of Pakistan and Japan was higher than the others but depreciation rate against Yen was lowest among the four currencies. More interestingly, in post 9/11 the trend growth rate of relative prices is 0.36 percent per month and depreciation rate per month is 0.40, which shows that Pak – Japan nominal exchange rate was adjusted according to the change in relative prices. This implies that PPP might hold between Pakistan and Japan. However, other results do not favour the hypothesis of PPP.

As discussed in the previous section that PPP holds if coefficient of domestic price is equal to one and coefficient of foreign price is equal to minus one. We checked it using OLS against all the four currencies, the results are reported in Table 8[15]. For Pak – US case though the coefficient of both foreign and domestic prices are significant but value of R^2 is too low but significant. However, from the null hypothesis formulated PPP does not hold in Pak – US case. Coefficient of domestic price is significant while foreign price is insignificant for Pak – UK case. R^2 is good and significant however, according to

[15] The estimated equation is $s_t = \beta + \alpha_0 P_t + \alpha_1 P_t^* + \vartheta_t$

null hypothesis PPP does not hold. Coefficient of foreign price is significant while domestic price is insignificant for Pak – Euro case. R^2 is good and significant however, according to null hypothesis, PPP does not hold. Coefficients of both domestic price as well as foreign price are significant for Pak – Japan case. R^2 is not too high but significant however, according to null hypothesis PPP does not hold.

Result of whether real exchange rate is mean reverting or not is reported in Table 9[16]. The Results are significant at five percent according to the hypothesis that mean reversion exist in real exchange rate for Pak – US and Pak – UK case. However for the other two currencies the coefficients are significant at ten percent, therefore the authenticity of mean reverting process is weak.

Table 8
PPP Results

	US	t-value	UK	t-value	Euro	t-value	Japan	t-value
B	1.24	0.67	-5.11	-3.49	-13.85	-6.46*	-41.51	-6.44*
α_0	-1.38	-2.67*	0.90	1.82***	0.87	1.46	1.36	6.53*
α_1	2.00	2.29*	1.17	1.51	2.99	2.96*	7.50	6.10*
R^2	0.15		0.81		0.85		0.49	
DW	0.28		0.79		0.63		0.73	
F-stat	4.16**		98.20*		134.54*		22.47*	
Null Hypothesis: $\alpha_0 = 1$ and $\alpha_1 = -1$								
F-statistic	18.04*		60.72*		97.80*		43.01*	
Chi-square	36.08*		121.44*		195.61*		86.02*	

Note: **, **, and *** indicate significance level at one, five and ten percent respectively*

Table 9
Mean Reverting Results

Variables	Pak – US	t-value	Pak – UK	t-value	Pak – Euro	t-value	Pak – Japan	t-value
α	0.48	2.00**	0.72	2.28**	0.35	1.71***	-0.13	-1.94***
ρ	0.88	14.98*	0.84	11.95*	0.92	18.31*	0.84	10.00*
R2	0.83	1.93***	0.76	2.30*	0.88	2.29**	0.69	1.93***
DW	1.93		2.30		2.29		1.93	
F-stat	224.4*		142.8*		335.4*		100.1*	
Null Hypothesis ρ =1								
F-statistic	3.97**		5.12**		2.83***		3.67***	
Chi-square	3.97**		5.12**		2.83***		3.67***	

Note: **, **, and *** indicate significance level at one, five and ten percent respectively*

[16] The estimated equation of mean revering process is $q_t = \alpha + \rho q_{t-1} + \varepsilon_t$

Table 7
Growth Rates

	Overall			Pre			Post		
	Compound	**Average**	**Trend**	**Compound**	**Average**	**Trend**	**Compound**	**Average**	**Trend**
Prices									
Pakistan	0.35	0.35	0.29	0.24	0.24	0.19	0.39	0.39	0.34
USA	0.19	0.19	0.18	0.22	0.22	0.24	0.19	0.18	0.20
UK	0.19	0.19	0.19	0.17	0.17	0.16	0.21	0.20	0.23
Euro Area	0.17	0.17	0.18	0.17	0.17	0.18	0.18	0.18	0.18
Japan	-0.03	-0.03	-0.04	-0.04	-0.04	-0.06	-0.02	-0.02	-0.02
Nominal Exchange Rate									
Pak – US	-0.25	-0.23	0.06	-1.52	-1.47	-1.46	-0.19	0.29	0.20
Pak – UK	-0.65	-0.60	-0.48	-1.38	-1.31	-1.28	0.48	-0.31	-0.61
Pak – Euro	-0.79	-0.73	-0.79	-1.39	-1.29	-1.40	0.69	-0.50	-1.00
Pak – Japan	-0.20	-0.14	-0.07	-0.92	-0.84	-0.41	0.06	0.14	-0.40
Real Exchange Rate									
Pak – US	-0.09	-0.07	0.18	-1.51	-1.46	-1.52	-0.39	0.50	0.34
Pak – UK	-0.49	-0.44	-0.38	-1.31	-1.24	-1.25	0.30	-0.11	-0.50
Pak – Euro	-0.62	-0.55	-0.68	-1.32	-1.23	-0.16	0.48	-0.28	-0.84
Pak – Japan	0.18	0.23	0.27	-0.64	-0.56	-0.16	-0.35	0.56	-0.04
Relative Prices									
Pak – US	0.16	0.16	0.12	0.01	0.02	-0.05	0.20	0.22	0.15
Pak – UK	0.16	0.16	0.10	0.07	0.07	0.03	0.18	0.20	0.11
Pak – Euro	0.17	0.18	0.11	0.07	0.07	0.01	0.21	0.22	0.16
Pak – Japan	0.38	0.38	0.34	0.28	0.28	0.25	0.41	0.42	0.36

Graph 1 – 4 show the movements of nominal and real exchange rate over the sample period. Graph 1 represents the movements of Rupee – Dollar real and nominal exchange rates. It shows that the gap between real and nominal exchange rate has started rising soon after 9/11 and after September 2003 it had widened more. Similar behavior has been depicted with Rupee – Sterling and Rupee – Euro real and nominal exchange rates. The gap started rising soon after 9/11 and widened more after November 2003. The behavior of Pak Rupee real and nominal exchange rates against Japanese Yen is totally different from the other three currencies. The gap between real and nominal exchange rate against Yen has started rising well before 9/11 event in November 2000, however, the gap widened more in Jan 2002 and in the end the gap widened even further after October 2003.

Graph 5 – 8 show the movements of nominal exchange rate and relative prices of the respective currencies. Graph 5 – 7 especially show that there could be long run relationship between relative prices and nominal exchange rate but there isn't short run linkages between the two. However, there is a possibility that the short run linkages may exist with some lags which is checked in the empirical analysis. In case of Pak – Japan, there does not seem to exist even long run relationship because the movements of exchange rate do not match with the movements in relative prices.

The correlation between nominal interest differential and nominal exchange rate shows mix result for different currencies (Table 10). Correlation between Pak – US nominal exchange rates and nominal interest differential is positive in both pre and post 9/11. However, correlation between Pak – Britain, Pak – Euro Area, and Pak – Japan nominal exchange rates with nominal interest differential respectively is negative in post 9/11 however it is positive in pre 9/11 except for Euro Area. Correlation between Pak – US real exchange rate and real interest differential is positive in both pre and post 9/11, while it is negative in both pre and post between Pak – Britain real interest differential and real exchange rate. Correlation between Pak – Euro real exchange rate and real interest differential and Pak – Japan real exchange rate and real interest differential is positive overall but later has negative correlation in pre 9/11 and positive in post 9/11 while former has positive correlation in pre 9/11 and negative in post 9/11. The nut shell of the correlation between exchange rate and interest differential is that the linkages between interest differential and exchange rate are not very significant. This could be due to lack of capital mobility between Pakistan and other countries or insensitivity of interest rate or there could be lagged adjustment in exchange rate due to change in interest rate.

Table 10
Correlation between Interest Differential and Exchange Rate

Variables	**Nominal Exchange Rate**			**Real Exchange Rate**		
	Overall	Pre	Post	Overall	Pre	Post
Pak – US	0.49	0.42	0.69	0.58	0.14	0.69
Pak – UK	-0.62	0.09	-0.58	-0.71	-0.71	-0.65
Pak – Euro	-0.72	-0.04	-0.65	0.22	-0.42	0.38
Pak – Japan	0.01	0.31	-0.41	0.31	0.14	-0.09

When Pakistan adopted flexible exchange rate the nominal interest rate was around 9 percent on average and now it has declined to less than 2 percent on average. In

Pre 9/11 era maximum nominal interest rate was 12.93 percent and minimum was 5.63 percent (Table 11). However, in post 9/11 era initially it was high as 10.41 percent in October 2001 and then it started declining. The minimum value of nominal interest rate was 0.74 percent in July 2003. The minimum value of real exchange rate in pre 9/11 was 5.84 percent when the nominal interest rate was 6.82 percent, the maximum real exchange rate was 12.04 percent when the nominal interest rate was 12.93 percent. Real interest rate was maximum at 9.90 percent in post 9/11 while minimum value was -0.03 percent in March 2004.

Volatility of nominal interest differential was higher in post 9/11 then pre 9/11 (Table 11). This is coherent with the statement of Janjua (2003) that after 9/11 the exchange rate is adjusted through changes in interest rate. Except for Rupee – Dollar exchange rate other currencies was more volatile in post 9/11. On the other hand volatility in real interest differential shows different results than nominal interest differential. Pak – Britain real interest differential was more volatile in pre 9/11 era than post 9/11, however, rest were more volatile in post 9/11. Similar to nominal exchange rate, except for Rupee – Dollar exchange rates was relatively more volatile in post 9/11 than pre 9/11

Graph 9 – 12 shows the movements of nominal interest differential and nominal exchange rate and Graph 13 – 16 shows the movements of real exchange rate and real interest differential. Graph 9 and Graph 13 both show similar positive correlated long run trend between Pak – US exchange rate and interest differential. Though the short run linkages do not seem to be very significant but long run link definitely exist between them. Graph 10 and Graph 14 show similar negatively correlated overall trend between Pak – Britain exchange rate and interest differential. The short run linkages between the two variables are not significant (even if they are some), however, there is long run relationship between them. Graph 11 and Graph 15 show different trend between Pak – Euro Area nominal interest differential and real interest differential. Negative co-movement is observed between the nominal variables while positive overall trend is observed between the real variables. The short run linkages between the two variables, however, are not very significant in both cases. Graph 12 and Graph 16 show different trends of Pak – Japan nominal and real interest differentials and nominal and real exchange rates. Negative overall trend has been observed between nominal exchange rate and nominal interest differential, while, positive overall trend has been observed between real exchange rate and real interest differential. From these Graphs we can say that there exist long run relationship between exchange rate and interest differential but short run linkages are not significant. However short run linkages might occur using some lag structure, i.e., there is a possibility that change in interest rate today affects exchange rate after 3 months..

Table 11
Interest Rate and Exchange Rate

	Nominal Interest Rate					Nominal Interest Differential				Nominal Exchange Rate			
	Pakistan	USA	UK	Euro	Japan	Pak – US	Pak – UK	Pak – Euro	Pak – Japan	Pak – US	Pak – UK	Pak – Euro	Pak – Japan
Maximum	12.93	6.28	5.75	5.47	1.90	7.27	7.51	7.59	11.31	64.20	106.11	72.43	0.55
Minimum	0.74	1.51	3.73	3.72	0.53	-1.80	-3.62	-3.32	-0.45	51.79	75.61	46.24	0.45
CV	61.37	38.44	10.46	10.35	24.09	128.23	557.28	450.87	79.29	4.22	7.78	12.08	5.14
						Pre 0911							
Maximum	12.93	6.28	5.75	5.47	1.90	7.14	7.51	7.59	11.31	64.20	94.37	58.78	0.54
Minimum	5.63	3.45	4.92	4.94	1.19	-0.65	-0.04	0.18	3.95	51.79	75.61	46.24	0.47
CV	24.36	17.63	5.31	3.48	15.64	59.86	62.46	59.66	29.27	6.82	6.11	7.08	3.87
						Post 0911							
Maximum	10.41	4.14	5.27	5.32	1.76	7.27	5.64	5.59	9.09	62.15	106.11	72.43	0.55
Minimum	0.74	1.51	3.73	3.72	0.53	-1.80	-3.62	-3.32	-0.45	57.22	84.92	51.80	0.45
CV	64.55	25.91	9.55	9.46	25.66	190.18	-322.41	-351.12	95.28	2.22	6.80	10.33	5.39
	Real Interest Rate					**Real Interest Differential**				**Real Exchange Rate**			
	Pakistan	USA	UK	Euro	Japan	Pak – US	Pak – UK	Pak – Euro	Pak – Japan	Pak – US	Pak – UK	Pak – Euro	Pak – Japan
Maximum	12.04	6.17	5.97	5.56	2.04	6.42	0.62	0.85	4.17	64.73	101.37	68.61	0.53
Minimum	-0.03	1.28	3.38	3.31	0.30	-2.60	-3.08	-0.75	2.08	51.78	75.45	46.18	0.42
CV	69.55	40.58	13.06	12.05	29.04	142.42	-58.73	407.68	15.57	5.08	6.14	10.25	6.28
						Pre 0911							
Maximum	12.04	6.17	5.97	5.56	1.94	6.30	0.62	0.53	4.17	64.73	93.22	57.99	0.53
Minimum	5.84	3.00	4.50	4.37	0.98	0.34	-1.65	-0.47	2.89	51.78	75.45	46.18	0.47
CV	23.69	19.21	10.03	7.28	19.05	51.01	-163.71	354.91	11.25	6.24	5.53	6.64	3.18
						Post 0911							
Maximum	9.90	4.02	5.17	5.16	2.04	6.42	-1.02	0.85	4.03	61.45	101.37	68.61	0.49
Minimum	-0.03	1.28	3.38	3.31	0.30	-2.60	-3.08	-0.75	2.08	53.98	82.62	51.23	0.42
CV	77.29	30.85	11.92	11.10	31.69	243.52	-25.06	426.31	15.96	3.51	5.61	8.93	3.38

Correlation between nominal money differential and nominal exchange rate shows positive correlation except for the US case because in post 9/11 due to high inflow of foreign exchange, exchange rate started appreciating against the Dollar. Initially exchange rate started appreciating against each currency but soon after it started depreciating except for Rupee – Dollar. The reason behind the appreciation against Dollar is the depreciation of Dollar itself against Sterling, Euro, Yen and other currencies. However, correlation between nominal money differential and nominal exchange rate was higher in post 9/11 era then in pre 9/11. On the other hand except for Japan the correlation between real money differential and real exchange rate was quite high in both pre and post 9/11 but still it was higher in post 9/11. Pak – US exchange rate is not behaving according to the theoretical relationship between money and exchange rate in post 9/11 era due to high inflow of foreign exchange reserves basically.

Table 12
Money Differential and Exchange Rate

	Nominal Money Differential and Nominal Exchange Rate			**Real Money Differential and Real Exchange Rate**		
	Overall	*Pre 9/11*	*Post 9/11*	*Overall*	*Pre 9/11*	*Post 9/11*
Pak – US	-0.38	0.08	-0.79	-0.58	0.84	-0.92
Pak – UK	0.87	0.53	0.91	0.83	0.67	0.90
Pak – Euro	0.92	0.57	0.93	0.90	0.83	0.89
Pak – Japan	0.28	0.47	0.76	-0.54	0.33	0.11

Graph 17 and Graph 18 show the trend of nominal and real money supply of Pakistan and four respective countries. It is clearly depicted from the both graphs that Pakistan has higher money growth than the other four countries. According to the monetary models, increase in money supply relative to the foreign country leads to exchange rate depreciation against that country's currency. Therefore there should be an upward trend in the exchange rate[17] if the money differential has upward trend. However, Graph 19 and Graph 23 shows that especially in post 9/11 period the trend between Pak – US money differential and exchange rate is negative. On the other hand Graphs 20 and 21 and Graphs 24 and 25 show that in both Pak – Britain and Pak – Euro Area money differential and exchange rate has upward movements. As discussed earlier that behaviour of nominal and real Pak – Japan was different especially after post 9/11 when exchange rate started adjusting after heavy appreciation, Graph 22 shows positive trend between nominal money differential and nominal exchange rate but Graph 26 shows pure random walk behaviour of real exchange rate.

Table 13 shows that the volatility in Pakistan's money supply was higher than the other four countries. Volatility of Pakistan's nominal as well real money supply increase by almost 4 times in post 9/11 compared to pre 9/11. Variation in nominal as well as real money supply of all the four countries was higher in post 9/11 compare to pre 9/11. Variation in nominal as well as real money supply of UK and Euro was lower in pre 9/11 than USA and higher in post 9/11, however, variation in real money supply of Japan was

[17] Exchange rate is taken as Rupee against Dollar and other currencies, therefore upward trend of exchange rate means depreciation.

higher than the other three countries in post 9/11. Money differential shows exactly opposite result of volatility as shown in Table 13. Volatility in nominal money differential especially has enormously declined in post 9/11 era. Volatility in nominal as well as real money differential was higher in pre 9/11 compared to post 9/11, especially, the variations in Pak-US and Pak-Britain nominal money differential were enormously declined in post 9/11.

Table 13
Volatility in Nominal and Real Money

	Nominal Money Supply			**Real Money Supply**		
	Overall	*Pre 9/11*	*Post 9/11*	*Overall*	*Pre 9/11*	*Post 9/11*
Pakistan	18.61	3.62	14.13	14.23	2.86	10.63
USA	8.13	3.47	4.85	5.74	2.42	2.98
UK	7.63	2.89	5.52	4.94	2.18	3.22
Euro	7.95	2.91	5.43	5.47	2.15	3.70
Japan	4.66	1.22	3.62	5.26	1.45	3.82
	Nominal Money Differential			**Real Money Differential**		
Pak – US	104.60	580.45	68.16	80.99	55.72	54.50
Pak – UK	92.83	225.26	56.31	93.10	94.29	60.88
Pak – Euro	89.14	81.85	56.68	88.41	102.24	54.54
Pak – Japan	75.97	62.13	46.85	83.65	67.66	52.39

Graph 27 – Graph 30 show that the changes in nominal exchange rate responds to the improvement and deterioration of trade balance in the following period (for all the four cases), i.e., deterioration of trade balance in January 2004 is responded by depreciation of nominal exchange rate in February 2004. Correlation (Table 14) between trade balance and change in exchange rate depicts the same result that the correlation though not very high but it is better when we measure it with lag behaviour. Graph 31 – Graph 34 show that real exchange rate responds to the trade balance with one period lag. The movements are more responded in pre 9/11 compares to post 9/11. On the other hand we can say that trade balance is adjusted after one period lag due to change in nominal and real exchange rate. Trade balance can only be adjusted spontaneous only if imports responds to the changes in exchange rate because due to having existing deals with the foreign companies exports do not respond so early to the changes in exchange rate[18]. Volatility in trade balance has increased in post 9/11 period compared to pre 9/11. Average trade balance has been increased from -6.8 percent of total average trade (average taken on monthly basis) in pre 9/11 to -7.2 percent of total average trade (average taken on monthly basis) in post 9/11, which is not a good news for the Government. However, average monthly imports in post 9/11 were increased by 23.6 percent while average monthly exports grew by 22.7 percent.

[18] For more details see Kemal and Qadir (2003) and Kemal (2004)

Table 14
Correlation between Trade Balance and Exchange Rate

	Changes in Trade Balance and Changes in Nominal Exchange Rate				Changes in Trade Balance and Changes in Real Exchange Rate			
	Pak – US	**Pak – UK**	**Pak – Euro**	**Pak – Japan**	**Pak – US**	**Pak – UK**	**Pak – Euro**	**Pak – Japan**
				Overall				
Level	0.29	-0.36	-0.29	-0.33	0.41	-0.29	-0.23	0.07
Lag	0.23	-0.42	-0.33	-0.39	0.37	-0.36	-0.26	0.07
				Pre 9/11				
Level	0.49	0.52	0.56	0.07	0.50	0.55	0.59	-0.10
Lag	0.35	0.32	0.33	-0.28	0.37	0.31	0.35	-0.38
				Post 9/11				
Level	0.29	-0.53	-0.40	-0.46	0.48	-0.46	-0.32	-0.06
Lag	0.22	-0.57	-0.43	-0.48	0.46	-0.50	-0.34	-0.10
	Trade Balance and Nominal Exchange Rate				**Trade Balance and Real Exchange Rate**			
				Overall				
Level	0.03	-0.07	-0.05	0.06	0.00	-0.10	-0.08	0.03
Lag	0.16	0.16	0.15	0.09	0.12	0.14	0.12	0.03
				Pre 9/11				
Level	0.02	-0.23	-0.28	0.25	-0.02	-0.28	-0.34	0.22
Lag	0.21	0.15	0.21	0.12	0.19	0.19	0.23	0.09
				Post 9/11				
Level	0.23	0.00	0.04	0.03	0.14	-0.02	0.01	0.00
Lag	0.41	0.15	0.12	0.05	0.16	0.11	0.07	0.03

In September 2001 the FOREX reserves were 2.15 Billion Dollar which soon after 9/11 went up to 3.1 billion Dollars in November 2001 and now it exceeds 11 Billion Dollars. Graph 35 shows that small changes in FOREX reserves lead to small changes in Pak – US exchange rate. On the other hand, large ups and downs in Pak – Britain, Pak – Euro and Pak – Japan exchange rate has been observed due to change in the FOREX reserves as shown in Graphs 36 – 38. It has been found that in post 9/11 era the correlation between Pak – US exchange rate and FOREX reserves is high and negative while with other currencies it is high and positive. While, in pre 9/11 the correlation was positive for all the currencies but lower than the post 9/11. The correlation between change FOREX reserves and changes in nominal and real exchange rate was positive but not too high. Variations in the changes in nominal exchange rate was higher in the post 9/11 compared to the pre 9/11. Variations in the changes in real exchange rate was enormously high in Pak – Britain and Pak – Euro case real exchange rate, while variation in the changes in real exchange rate has declined in post 9/11 in Pak – US and Pak – Japan real exchange rate.

Table 15
Correlation between FOREX Reserves and Exchange Rate

	FOREX Reserves and Nominal Exchange Rate			FOREX Reserves and Real Exchange Rate		
	Overall	***Pre 9/11***	***Post 9/11***	***Overall***	***Pre 9/11***	***Post 9/11***
Pak – US	-0.38	0.61	-0.96	-0.60	0.59	-0.95
Pak – UK	0.82	0.70	0.82	0.78	0.69	0.84
Pak – Euro	0.92	0.67	0.94	0.91	0.68	0.94
Pak – Japan	0.17	0.41	0.67	-0.62	0.20	0.09
	Change in FOREX Reserves and Changes in Nominal Exchange Rate			**Change in FOREX Reserves and Changes in Real Exchange Rate**		
Pak – US	0.31	0.33	0.53	0.32	0.39	0.38
Pak – UK	0.07	0.04	0.16	0.09	0.07	0.16
Pak – Euro	0.06	0.05	0.10	0.05	0.05	0.07
Pak – Japan	0.32	0.36	0.33	0.31	0.36	0.32

Table 16
Variations in Changes in Exchange Rate

	Nominal Exchange Rate			Real Exchange Rate		
	Overall	***Pre 9/11***	***Post 9/11***	***Overall***	***Pre 9/11***	***Post 9/11***
Pak – US	-852	-211	263	-3060	-218	209
Pak – UK	-497	-292	-833	-713	-317	-2428
Pak – Euro	-491	-355	-628	-660	-368	-1185
Pak – Japan	-2269	-488	2067	1436	-748	531

VI. Empirical Findings and Results

We have estimated 3 models for each real and nominal exchange rate, which makes 6 estimated models overall. This section elaborates the empirical findings of these models which are discussed in the Section 5.

VI.1. Model 1: Monetary Model

VI.1a. Real Exchange Rate, Real Interest Differential, and Real Monetary Differential

Pak – US: Monthly changes in real exchange rate are affected by the 12 month lag of the real money differential, and 11 month lag of real interest differential (Table 17). This shows that frequent changes in real money differential and real interest differential are not significantly explaining the movements in real exchange rate. Results of IRF (Graph A1) show that real exchange rate instantaneously adjust to its own shock and restore the equilibrium. It is also observed that it then overshoots in the next month followed by appreciation in it after that to restore the equilibrium. Shock to real money differential is not responded by the real exchange rate instantaneously, however, graph shows some

downward adjustments after five months but the equilibrium is not restored. The shock caused by real interest differential affect the real exchange rate after two months. It then starts adjusting towards equilibrium, however, in the fourth month the shock is almost zero. Shock caused by real exchange rate is responded by real money differential after two months while, the impact of shock prevails in the real interest differential and after 4 months it sharply declines.

Pak – UK: Monthly changes in real exchange rate are affected by the six month lag of real money differential and 12 month lag of the real interest differential (Table 17). However, it also follows its own 5 month lag changes. The findings are also coherent with the Pak – US case that changes in both the monetary fundamentals; real money differential and real interest differential are not significantly responded by the real exchange rate instantaneously (after one or 2 months). Similar to the Pak – US case, real exchange rate overshoots initially and then appreciates to restore equilibrium in 4^{th} month as shown by the Graph A2. Small shock is caused by real money differential which is responded in the same way by real exchange rate and equilibrium restores after 2 months, however, after that the movements in real exchange rate are quite random. The response of real exchange rate due to shock caused by real interest differential is very slow and exchange rate partially adjusts after 4 months by appreciation in real exchange rate followed by little depreciation. Real money differential responds well to the temporary changes in real exchange rate but the equilibrium is not fully restored. Similar behaviour has been shown by the response of real interest differential due to chock caused by real exchange rate. However, both variables adjust towards equilibrium but the movements are very random.

Pak – Euro: Opposite of the above two results, the changes in real exchange rate are significantly explained by the changes in real money differential (lags 1, 2, 3, 4, 5, 9 are significant) and the changes in real interest differential (lags 1, 2, 3, 4, 5, 6, 10, 11) (Table 17). Moreover, the movements of real exchange rate are also explained by its own lagged movements (Lags 1, 2, 3, 10, 12 are significant), which shows the presence of random walk behaviour of real exchange rate. Results of IRF (Graph A3) show that real exchange rate moves randomly initially after a shock appears in it and adjustments starts after 5 months with a sharp movements towards equilibrium and the equilibrium is restored after 8 months and further adjustment is done after 2 further months. Very little shock caused by real money differential is responded by huge appreciation in real exchange rate in the next month but it then starts adjusting downwards and equilibrium is restored after 4 months followed by some more adjustments in the next two months. Shock caused by real interest differential is however, not responded by real exchange rate instantaneously but it does respond after 5 months. The impact of shock caused by real exchange rate is very small in the first period on real money differential, however, the shock prevails upto two periods and then real money differential adjusts but the equilibrium is not fully restored. On the other hand the movements in real interest differential are very random due to temporary changes in real exchange rate and the equilibrium is not restored.

Pak – Japan: Similar to the Pak – Euro case, the real exchange rate behaviour is significantly explained by real money differential (lags 2, 3, 4, 6, and 12 are significant)

and real interest differential (lags 2, 4, 5, 6, 9, 10, 12 are significant) as shown in Table 17. Moreover, the changes in real exchange rate are also explained by its own lags, which show the random behaviour of real exchange rate (lags 3, 4, and ten are significant). IRF results (Graph A4) show that after appearing the shock real exchange rate overshoots initially in the next month followed by appreciation. It then adjusts more to restore equilibrium in terms of depreciation after 4 months. Very little impact on real exchange rate has been observed initially due to shock caused in real money differential, however, the adjustments starts after two months and after one quarter of the shock the equilibrium is restored. Shock caused by real interest differential is responded by real exchange rate after two months by an excess appreciation but the equilibrium is not restored. Instantaneous adjustments is observed in real money differential due to shock caused by real exchange rate, while real interest differential adjusts towards equilibrium after three months due to shock cause by real exchange rate.

VI.1b. Nominal Exchange Rate, Nominal Interest Differential, Nominal Money Differential, and Relative prices

Pak – US: Monthly changes in nominal exchange rate are affected its own 5 months lags, while behaviour of other variables are insignificant in explaining the short run movements in nominal exchange rate (Table 17). This shows that nominal exchange rate, in case of Pak – US, is not explained by monetary model. Results of IRF (Graph A5) show that the adjustment in exchange rate is instantaneous (in the next month) after the shock. Nominal exchange rate adjusts instantaneously due to shock caused by nominal money differential, however, it again deviates from the equilibrium in the next period after adjustment but adjusts back in the next month again. The adjustment in nominal exchange rate starts after two months of shock caused by nominal interest differential and the equilibrium is completely restored after 9 months, which is quite a long period. Similarly, nominal exchange rate starts adjusting after two months of shock caused by relative prices and the equilibrium is completely restored after 9 months, which is quite a long period. Adjustment in nominal money differential due to shock caused by nominal exchange rate is instantaneous (after one month). The adjustment in nominal interest differential due to shock caused by nominal exchange rate is very slow and the equilibrium is restored after 7 months, while adjustment in relative prices starts after 3 months and the equilibrium is restored after 6 months.

Pak – UK: Monthly changes in nominal exchange rate is explained only by the 12 month lag changes in relative price, while none of the other variables explain the changes in nominal exchange rate significantly (Table 17). Results of IRF (Graph A6) show that the adjustment in nominal exchange rate due to its own shock is instantaneous and in the next month of shock the equilibrium is restored. This shows that temporary appreciation or depreciation in nominal exchange rate is instantaneously adjusted by itself in the floating era. Nominal exchange rate depreciates more than what is needed due to shock caused by nominal money differential, however, it adjusts back to restore equilibrium in the next month. Similarly, nominal exchange rate depreciates more than what is needed after the shock appears in nominal interest differential, however, it adjusts back in the next month and the equilibrium is restored after 5 months. Similar to previous adjustments nominal

exchange rate depreciates more and then adjustments is done by an appreciation in it due to shock appears in relative prices, however, the impact of shock is adjusted in 4 months and the shock is minimised. Nominal money differential responds to the shocks in nominal exchange rate but the equilibrium is not restored instantaneously. The movements of nominal interest differential is very random when the shock appears in nominal exchange rate, however, it restores the equilibrium after 11 months or year. Relative prices responds quickly to the shock appears in the nominal exchange rate, the equilibrium is restored after 4 months.

Pak – Euro: Monthly changes in nominal exchange rate are explained significantly by the 2 month lag of nominal money differential, 12 month lag of both nominal interest differential and relative prices (Table 17). The movements in nominal exchange rate are also explained by its own 12 month lagged changes. Results of IRF (Graph A7) show that nominal exchange rate adjusts instantaneously due to shock appears in itself. However, the adjustment is then followed by excess depreciation in nominal exchange rate which was then cleared by appreciation in nominal exchange rate. Appearance of shock in the nominal money differential is instantaneously responded by the nominal exchange rate but the equilibrium is restored after 7 months, before that it behaves like a random walk. Response to the shock appears in nominal interest rate by nominal exchange rate is spontaneous and the equilibrium is restored after 3 months. Very little shock appears in the relative price cause huge deviations in the nominal exchange rate and the equilibrium is not restored even till 12 months. The response of nominal money differential due to appearance of shock in nominal exchange rate is spontaneous but the movements are very random and the equilibrium is restored after 8 months and slight adjustment is done in 9^{th} month. Nominal interest differential responds spontaneously to the shock appears in nominal exchange rate, however, the equilibrium is restored after 4 months. Relative prices adjusts spontaneously sue to shock appears in nominal exchange rate, however, the equilibrium is restored after 9 months which is quite a long period.

Pak – Japan: Monthly changes in nominal exchange rate are only explained by the 6 months lag of relative prices, none of the other variables significantly explain the short run movements in nominal exchange rate (Table 17). Results of IRF (Graph A8) show that nominal exchange rate adjusts instantaneous to its own shock and the equilibrium is restored after 4 months and then some minor adjustments are done after 7 months. Shock caused by nominal money differential are well responded by the nominal exchange rate but the equilibrium is restored after 9 months. Nominal exchange rate initially appreciates in response to the shock appears in nominal interest rate and then starts adjusting towards equilibrium. Though the equilibrium is partially restored after 6 months but the complete adjustment is done after 9 months when the equilibrium is fully restored. The shock appears in relative prices is responded by the nominal exchange rate instantaneously but the movements are quite up and down and the equilibrium is not restored till one year. Nominal money differential responds to the shock appears in nominal exchange rate but the equilibrium is not restored fully. The up and down movements of nominal interest differential due to appearance of shock in nominal exchange rate shows that equilibrium is not restored fully, however, the shock is minimized by the adjustments in nominal interest differential after 4 months and 10 months. Impact of shock in nominal exchange

rate on relative prices prevails for 4 months and then it starts adjusting, however, the impact of shock is minimized by relative prices after 7 months.

VI.2. Model 2: Trade

VI.2a. Real Exchange Rate, Exports and Imports

Pak – US: Monthly changes in real exchange rate are significantly explained by the changes in imports (lags 1, 2, 4, 5, 6, and 9 are significant) and changes in exports (lags 1, 2, 3, 4, 5, 6, 11, and 12 are significant) as shown in Table 18. The movements are also explained by its own monthly changes (lags 1, 2, 3, 4, 6, 10 and 12 are significant). This shows that the monthly changes in real exchange rate are significantly explained the trade model. Results of IRF (Graph A9) show that real exchange rate instantaneously adjusts but overshoots from the equilibrium level, however it then remains stable and adjustment starts after three months but the equilibrium is not restored. Real exchange rate adjusts instantaneously due to shock appears in imports but the equilibrium is not restored. Real exchange rate adjusts spontaneously due to shock appears in exports but the equilibrium is restored after 5 months. Imports adjust instantaneously due to shock appears in real exchange rate and the equilibrium is restored after 3 months. Exports instantaneously responds to the shock appears in real exchange rate, however, after many ups and down the equilibrium is restored after 9 months.

Pak – UK: Monthly changes in real exchange rate are explained by 9^{th} and 10^{th} month lag of imports and 9^{th} month lag of exports as shown in Table 18. Moreover it is also explained by its own 9^{th} month lagged movements. Results of IRF (Graph A10) show that real exchange rate adjusts instantaneous due to shock and equilibrium is restored after 7 months. Instantaneous adjustment is observed in real exchange rate due to appearance of shocks in imports and the equilibrium is restored after 6 months. Random behaviour or real exchange rate is observed in each month due to shock appears in exports and the equilibrium is not restored fully but the shock is minimized after 3 months. Imports instantaneously adjusts due to shock appears in real exchange rate and the shock is minimized after two months, however, after that the changes in imports are very random. Shock appears in real exchange rate is instantaneously adjusted by exports and the equilibrium is restored after two months.

Pak – Euro: Monthly changes in real exchange rate are explained by 4^{th} and 9^{th} months lag of imports and 6^{th}, 9^{th}, 10^{th} and 12^{th} month lag of exports as shown in Table 18. Moreover the movements are also explained by the first and second months lagged changes in real exchange rate. Results of IRF (Graph A11) show that real exchange rate instantaneously adjusts after the shock, though the equilibrium is not restored fully but the shock is minimised in the next month of shock. Equilibrium is restored by real exchange rate after three months when a shock appears in imports, while, equilibrium is restored after 4 months when a shock appears in exports. Adjustment in imports and exports is instantaneous when a shock appears in real exchange rate but the equilibrium is restored after 5 months and 9 months respectively.

Pak – Japan: Monthly changes in real exchange rate are significantly explained by the changes in imports (lags 1, 2, 4 and 10 are significant) and exports (lags 3, 4, 5, 6, 9, and 12 are significant) as shown in Table 18. Moreover, it is also explained by its own lag behaviour (lags 5, 9 and 12 are significant). Real exchange rate adjusts instantaneously after the shock but the equilibrium is not restored, however, the shock is minimised after two years. Real exchange rate adjusts instantaneously when a shock appears in imports and the equilibrium is restored after 3 months. On the other hand, real exchange rate adjusts after one period of the appearance of shock in exports and the equilibrium is restored after 4 months. Imports adjusts instantaneously due to shock appears in real exchange rate and equilibrium is restored after 5 months, while, exports adjust instantaneously but the equilibrium is restored, however, the shock is minimised.

VI.2b. Nominal Exchange Rate, Exports and Imports

Pak – US: Monthly changes in nominal exchange rate are explained by lags 2 and 3 of imports and 4^{th} lag of exports as shown in Table 18. Moreover it is also explained by its own 4^{th} month changes. Results of IRF (Graph A13) show that nominal exchange rate adjusts after two periods and the equilibrium is restored after 5 months. Adjustment in nominal exchange rate starts after one period of the appearance of shock in imports but the equilibrium is not restored in the short run. Nominal exchange rate adjusts instantaneously after the shock appears in exports and the shock is minimised after three months. Adjustment in imports due to shock in nominal exchange rate is instantaneous but the equilibrium is not restored fully. On the other hand, adjustment in exports due to shock in nominal exchange rate is instantaneous and the equilibrium is restored after 4 months.

Pak – UK: Monthly changes in nominal exchange rate are explained by the 9 months lag of both exports and imports, however, its own lags are insignificant as shown in Table 18. Results of IRF (Graph A14) show that nominal exchange rate depreciates more than what is needed and then adjusts back, however, the equilibrium is completely restored after 6 months. Nominal exchange rate adjusts instantaneously when a shock appears in imports but the equilibrium is not restored fully, however, the shock is minimised after 6 months. On the other hand, when a shock appears in exports, nominal exchange rate adjusts after two months but the equilibrium is not fully restored, however, the shock is minimised after three months. Imports adjusts instantaneously when a shock appears in nominal exchange rate but the equilibrium is not restored, while, exports adjusts instantaneously and the equilibrium is restored after 8 months.

Pak – Euro: Monthly changes in nominal exchange rate are explained by the imports (lags 1, 4, and 9 are significant) and exports (lags 4, 6, 9, 10. 11 are significant) as shown in Table 18. Moreover, the movements are also explained by 1^{st} month lag of nominal exchange rate. Results of IRF (Graph A15) show that nominal exchange rate adjusts instantaneously due to its own shock and the equilibrium is restored after 7 months. Nominal exchange rate responds instantaneously when a shock appears in imports, while, it adjusts after two months when shock appears in exports, however, the equilibrium is restored after 10 months and 12 months respectively. Adjustment in imports and exports

is spontaneous due to shock appears in nominal exchange rate, however, the equilibrium is restored after 8 months in case of imports and after 4 months in case of exports.

Pak – Japan: Monthly changes in nominal exchange rate are explained by imports (lags 1, 2, 4, and 5 are significant) and exports (lags 3, 4, 5, 6, 9, and 12 are significant) as shown in Table 18. Moreover, it is also explained by the lags of changes in real exchange rate (lags 4, 10 and 12 are significant). Results of IRF (Graph A16) show that nominal exchange rate adjusts instantaneously after the shock and the equilibrium is restored after 4 months. Random behaviour is observed in nominal exchange rate when a shock appears in both imports and exports. The equilibrium is not restored but the shock is minimised after 4 months and 5 months respectively. Imports respond instantaneously when the shock appears in nominal exchange rate, however, the equilibrium is not fully restored but the shock is minimised after one month. Exports respond instantaneously when the shock appears in nominal exchange rate, however, the equilibrium is not restored but the shock is minimised after two months.

VI. 3. Model 3: Exchange Rate – FOREX Relationship

VI.3a. Real Exchange Rates and FOREX Reserves

PK – US: Monthly changes in real exchange rate are significantly explained by 6^{th} month lagged changes in FOREX reserves as shown in Table 19. The movements are also explained by its own lags (lags 4 and 11 are significant). Results of IRF (Graph A17) show that real exchange rate adjusts instantaneously after one month of shock, however, real exchange rate overshoots initially but the equilibrium is restored after 7 months. However, adjustment in real exchange rate when shock appears in FOREX reserves starts after two months and the equilibrium is restored after four months. Adjustment in FOREX reserves due to shock caused by real exchange rate shows that equilibrium is not restored but the shock is minimized after 7 months.

Pak – UK: Monthly changes in real exchange rate are significantly explained by changes in FOREX reserves (lags 1, 8, and 10 are significant) as shown in Table 19. Moreover the movements are also significantly explained by its own lagged movements (lags 1, 2, 3, 4, 5, 6, 7, and 9 of are significant. Results of IRF (Graph A18) show that real exchange rate adjusts instantaneously soon after the shock but initially overshoots the equilibrium and then adjusts back to restore the equilibrium, however, the equilibrium is restored after 4 months. Real exchange rate instantaneously responds when a shock appears in FOREX reserves but the equilibrium is minimized after one year. This graph shows that shock in real exchange rate due to FOREX reserves is generally caused by decline in FOREX reserves. Shock in real exchange rate is instantaneously responded by FOREX reserves but the equilibrium is restored after 11 months.

***Pak – Euro*:** Monthly changes in real exchange rate are explained by the changes in FOREX reserves (lags 1, 7 and 8 are significant) and its own first and 12th month lagged movements as shown in table 19. Results of IRF (Graph A19) shows that real exchange rate adjusts instantaneously but real exchange rate behaves as a random walk, however,

the shock is minimized after 8 months. Real exchange rate responds instantaneously to the shock in FOREX reserves but the equilibrium is restored after 6 months. The adjustment in FOREX reserves is instantaneous when a shock appears in real exchange rate, however, the equilibrium is restored after 4 months.

Pak – Japan: Surprisingly, monthly changes in real exchange rate are neither explained by changes in FOREX reserve nor by its own movements as shown in Table 19. This shows that Pak – Japan real exchange rate is not adjusted due to short run changes in FOREX reserves. Results of IRF (Graph A20) show that real exchange rate overshoots initially and then adjusts back in terms of appreciation and restores the equilibrium. Real exchange rate instantaneously adjusts when a shock appears in FOREX reserves and the equilibrium is restored after 4 months. Shock in real exchange rate spontaneously responded by FOREX reserves, however, the shock is minimized after 7 months.

VI.3b. Nominal Exchange Rates and FOREX Reserves

Pak – US: Monthly changes in nominal exchange rate are significantly explained by changes in FOREX reserves (lags 2, 6, 7, 8, 9, 10, 11, 12 are significant) a shown in Table 19. Moreover the movements are also explained by its own changes (lags 2, 3, 4, 5, 6, 7, 8, 10, and 11 are significant). The estimates show that the movements of nominal exchange rate are significantly explained by FOREX reserves and its own lags. Results of IRF (Graph A21) show that nominal exchange rate adjusts instantaneously and the shock is minimized after one month but the equilibrium is not completely restored. Shock appears in FOREX reserves is responded by nominal exchange rate after two months and in the third month the equilibrium is restored. Shock in nominal exchange rate is responded by FOREX reserves after two months and the shock is minimized.

Pak – UK: Movements in nominal exchange rate are significantly explained by first ten lags of nominal exchange rate and FOREX reserves (lags 1, 3, 8, 9, 10, 11, and 12 are significant) as shown in Table 19. Results of IRF (Graph A22) show that nominal exchange rate adjusts instantaneously but the equilibrium is restored after 11 months. Nominal exchange rate adjusts instantaneously due to shock appears in FOREX reserves and the equilibrium is restored after 7 months. FOREX reserves adjusts instantaneously when shock appears in nominal exchange rate and the equilibrium is restored after 3 months.

Pak – Euro: Monthly changes in nominal exchange rate are significantly explained by the changes in FOREX reserves (lags 1 and 8 are significant). Moreover its movements are also explained by its own lagged movements (lags 1, 3, 4, 11, and 12 are significant) as shown in Table 19. Results of IRF (Graph A23) show that nominal exchange rate adjusts instantaneously. However, the movements in nominal exchange rate are very random and the shock is minimized after 8 months. Shock in FOREX reserves instantaneously responded by nominal exchange rate and the equilibrium is restored after 9 months. Shock appears in nominal exchange rate is instantaneously responded by FOREX reserves. However, the equilibrium is not fully restored but the shock is minimized after 4 months.

Pak – Japan: Monthly changes in nominal exchange rate are not explained by the movements in FOREX reserves but lag 1 of change in nominal exchange rate is significant in explaining the movements in nominal exchange rate as shown in Table 19. Result of IRF (Graph A24) show that nominal exchange rate adjusts instantaneously after the shock and equilibrium is restored after 4 months. Nominal exchange rate adjusts instantaneously when shock appears in FOREX reserves and the equilibrium is restored after 8 months. FOREX reserves responds after two months to the shock appears in nominal exchange rate and the shock is minimized after 4 months.

VII. Summary and Conclusions

We've analysed the behaviour of exchange rate, interest rate, interest differential, money supply, money differential, prices, relative prices, forex reserves, imports and exports. SVAR model is also estimated to check the short – run responses with respect to the movements in fundamentals on both nominal and real exchange rate and their own lags.

Prices in Pakistan were more stable in pre 9/11 than post 9/11 which could be due to recent oil price hike. Pak – Euro nominal exchange rate volatility was higher among all the four currencies which support our results of high correlation (association) between exchange rate and interest differential in Pak – Euro case. As discussed by Janjua (2003) that interest rate is used as a main monetary tool to adjust exchange rate in post 9/11, it has been found that volatility in interest differential was higher in post 9/11. An important result is the significant relationship between movements in nominal and real exchange rate, which are highly correlated in both pre and post 9/11 periods. The gap between the nominal and real exchange rate has widened after 9/11, which is the major concern for the policymakers.

Changes in Forex reserves are responded by Pak-Euro and Pak-UK exchange rates. However, the Pak-US nominal exchange rate is affected by Forex Reserves and not the real exchange rate.

The trade model explains the movements in real exchange rate significantly for Pak – US, Pak - Euro and Pak – Japan as well as the movements in nominal exchange rate between Pak – Euro and Pak - Japan. Monetary model significantly explains the movements in real exchange rate especially in case of Pak – Euro, while, movements in nominal exchange rate are not significantly explained by the monetary model though each of the four variables explain movements in nominal exchange rate in Pak – Euro case.

The most important finding of this study is that real exchange rate always overshoots in response to some shock and then adjusts back to restore the equilibrium, although the adjustment process varies in different cases. The real exchange rate is not completely a random walk model and the movements are also explained by other fundamentals. This result coincides with the findings of Macdonald (1999) and Macdonald and Taylor (1994). The behaviour of nominal and real exchange rate is quite different in terms of how much they are explained by other variables and their adjustment behaviour to some shocks. Temporary appreciation or depreciation in nominal exchange rate is instantaneously adjusted by itself in the floating era.

Variation pattern in Pak-US exchange rate is different from other three exchange rates. Exchange rate did not capture frequent changes in Pak-US relative prices frequently. PPP does not hold for the recent floating period. This result conforms to the theory and the facts that productivity growth and prices of traded and non traded goods are not similar between Pakistan and other countries. There might exist the long run relationship between relative prices and exchange rate, which is not checked in this study due to small sample size. Though it has been found that Pak-Euro and Pak-Japan exchange rate has mean reverting properties the other two do not have. But we may have type 1 and type 2 errors, which can be exploded by rigorous studies.

Changes in nominal exchange rate and real exchange rate are highly correlated and because relative prices is not significantly correlated with nominal exchange rate, we might say that nominal exchange rate variations cause real exchange rate variations.

In pre 9/11, the interest rates were too high but it started declining in post 9/11. In post 9/11, the link between interest differentials and exchange rates is negative. Moreover, the volatility in interest rate was higher in post 9/11 because it is the main monetary tool used to adjust the exchange rate in the last era especially and this is my thinking that now when interest rates are quite low Pakistan should think thrice before changing the interest rate because a frequent changes in a wrong direction can affect the fiscal debt and other variables including exchange rate. Moreover, it has also been observed, though not analysed, in this study that inflationary gap has widened in the last two years; therefore, there is a potential that inflation can increase at any time. Therefore, some policy should be adopted which can tackle the expected increase in inflation, and contain the current expected inflation.

One important conclusion which we draw is the adjustment behaviour of ER due to shock caused by FOREX reserves that it adjusts and restores the equilibrium in case of Pak-US and Pak-Japan. Therefore, keeping reserves in dollars and yen is safer. Overall we concluded that somehow Pakistan currency is more linked to Euro than any other currency.

Table 17
Estimates of Monetary Model

Real Exchange Rate						Nominal Exchange Rate					
Variables	**Lags**	**Pak-US**	**Pak-UK**	**Pak-Euro**	**Pak-Japan**	**Variables**	**Lags**	**Pak-US**	**Pak-UK**	**Pak-Euro**	**Pak-Japan**
Exchange Rate	1	-0.21	0.47	-0.52**	-0.58	**Exchange Rate**	1	0.10	0.05	-0.25	-0.08
Exchange Rate	2	-0.50	0.54	-0.96*	-1.41	**Exchange Rate**	2	0.17	-0.14	0.34	0.11
Exchange Rate	3	-0.34	-0.07	-0.61*	-1.47**	**Exchange Rate**	3	0.07	-0.11	-0.13	-0.17
Exchange Rate	4	-0.92	0.26	-0.14	-1.54*	**Exchange Rate**	4	-0.39	0.21	0.68	-0.41
Exchange Rate	5	0.16	1.36***	-0.32	-0.89	**Exchange Rate**	5	-0.60**	-0.28	0.21	-0.41
Exchange Rate	6	-0.26	-0.36	0.28	0.94	**Exchange Rate**	6	0.10	0.44	0.18	-0.17
Exchange Rate	9	-0.38	0.09	0.06	-0.53	**Exchange Rate**	12	0.03	-0.15	-0.60**	0.01
Exchange Rate	10	0.37	-0.40	-0.60*	-0.95**	**Money Differential**	1	-0.09	0.43	0.53	0.37
Exchange Rate	11	-0.22	1.97	0.38	-0.27	**Money Differential**	2	0.002	-0.35	-0.91**	0.12
Exchange Rate	12	-0.07	1.09	0.63**	0.45	**Money Differential**	3	-0.08	-0.11	0.31	-0.25
Money Differential	1	0.32	1.85	-1.68*	-0.19	**Money Differential**	4	-0.05	-0.65	-0.60	0.05
Money Differential	2	0.47	1.83	-2.51*	-1.95*	**Money Differential**	5	-0.11	0.40	1.11	-0.14
Money Differential	3	0.48	-0.08	-2.26*	-2.07*	**Money Differential**	6	-0.12	0.57	0.07	0.06
Money Differential	4	0.60	1.16	-2.50*	-1.55**	**Money Differential**	12	0.03	0.43	-0.24	-0.21
Money Differential	5	-1.00	0.19	-0.87*	1.09	**Interest Differential**	1	-0.0003	-0.01	-0.01	-0.003
Money Differential	6	-1.09	1.24*	0.01	1.27***	**Interest Differential**	2	-0.001	-0.01	0.01	-0.003
Money Differential	9	-0.51	0.89	-0.63***	0.39	**Interest Differential**	3	-0.003	-0.01	0.01	-0.01
Money Differential	10	-0.34	-1.26	-0.19	0.48	**Interest Differential**	4	-0.002	0.01	0.02	-0.01
Money Differential	11	-2.53	-1.52	-0.59	-0.70	**Interest Differential**	5	-0.002	0.005	0.01	-0.01
Money Differential	12	-2.01**	-1.13	-0.39	-1.36**	**Interest Differential**	6	0.0005	0.01	0.01	-0.002
Interest Differential	1	0.00002	-0.04	0.12*	-0.03	**Interest Differential**	12	-0.001	0.01	0.01***	0.002
Interest Differential	2	0.0047	0.01	0.29*	-0.05***	**Relative Prices**	1	-0.07	-1.85	-1.10	0.31
Interest Differential	3	0.003	-0.04	0.38*	-0.03	**Relative Prices**	2	-0.49	3.08	2.53	-0.37
Interest Differential	4	0.00004	-0.07	0.35*	-0.10**	**Relative Prices**	3	0.42	-0.50	-1.88	-0.98
Interest Differential	5	0.01	0.07	0.24*	-0.10*	**Relative Prices**	4	0.38	1.31	3.84	2.36
Interest Differential	6	0.003	0.13	0.15*	-0.07***	**Relative Prices**	5	0.51	0.02	-4.95***	-1.04
Interest Differential	9	0.003	-0.03	-0.06	0.11**	**Relative Prices**	6	-0.03	0.13	1.40	2.34***
Interest Differential	10	0.004	-0.18	-0.09**	0.09**	**Relative Prices**	12	0.21	4.35*	3.13***	1.31
Interest Differential	11	0.01**	-0.08	-0.11*	0.002	**Constant**		0.01***	-0.02	0.004	-0.03
Interest Differential	12	0.001	-0.06**	-0.04	-0.06*	**Dummy-1**		-0.003	-0.01	-0.07	
Constant		0.04*	-0.07***	0.12*	0.05**	**Dummy-2**					0.05*
Dummy-1		-0.09	0.45***	-0.11							
Dummy-2			-0.01		0.13*	**R^2**		0.83	0.76	0.88	0.87
R^2		0.88	0.79	0.97	0.95						

Note: **, **, and *** indicate significance level ate one, five and ten percent respectively*

Table 18
VAR Estimates of Trade Model

Variables	Lags	Real Exchange Rate				Nominal Exchange Rate			
		Pak-US	Pak-UK	Pak-Euro	Pak-Japan	Pak-US	Pak-UK	Pak-Euro	Pak-Japan
Exchange Rate	1	-0.29**	-0.68	0.53**	0.22	-0.15	-0.47	0.53**	-0.02
Exchange Rate	2	-1.20*	0.12	0.42***	0.33	-0.37	0.11	0.22	0.26
Exchange Rate	3	-0.52*	0.08	-0.43	-0.49	-0.50	-0.004	-0.32	-0.16
Exchange Rate	4	-0.74*	-0.33	0.25	-0.13	-0.66*	-0.15	0.07	-0.38**
Exchange Rate	5	0.01	0.37	-0.31	-0.41***	0.52***	-0.22	-0.35	-0.29
Exchange Rate	6	-0.54*	-0.62	-0.14	0.04	0.59*	-0.09	0.01	0.16
Exchange Rate	9	-0.17	-0.60**	-0.06	-0.44**	0.79	-0.53	-0.05	-0.38
Exchange Rate	10	0.32*	-0.29	-0.21	-0.88*	0.30	-0.09	-0.26	-0.62*
Exchange Rate	11	-0.23	0.04	0.00	0.22	-0.07	0.02	0.22	0.21
Exchange Rate	12	-0.36*	-0.05	-0.26	0.31***	0.03	-0.09	-0.27	0.35**
Imports	1	-0.05*	-0.08	-0.10	-0.20*	-0.02	-0.08	-0.15**	-0.21*
Imports	2	-0.07*	-0.01	-0.03	-0.16*	-0.04***	-0.14	-0.03	-0.20*
Imports	3	-0.004	-0.04	-0.02	0.02	-0.07**	-0.14	-0.05	-0.03
Imports	4	0.07*	0.20	0.20**	0.24*	-0.02	0.10	0.21**	0.25*
Imports	5	0.06**	0.17	0.07	0.13	0.03	0.18	0.03	0.19**
Imports	6	0.04*	0.12	0.09	-0.05	0.01	0.05	0.10	0.07
Imports	9	-0.03**	0.15*	0.21*	-0.09	-0.01	0.18**	0.19**	-0.05
Imports	10	-0.03	0.21***	0.04	-0.16**	0.03	0.14	0.06	-0.05
Imports	11	-0.01	-0.01	-0.02	-0.07	-0.04	-0.06	0.003	0.01
Imports	12	0.02	-0.07	0.01	-0.04	-0.01	-0.04	0.02	0.01
Exports	1	-0.09*	-0.09	0.05	-0.001	0.02	0.01	0.02	0.01
Exports	2	-0.10*	0.07	0.09	-0.04	-0.01	0.09	0.07	0.03
Exports	3	-0.15*	0.05	-0.03	-0.12*	-0.03	0.09	-0.05	-0.12**
Exports	4	-0.12*	-0.06	-0.14	-0.14**	-0.06***	-0.08	-0.21**	-0.19*
Exports	5	-0.09*	0.03	0.04	-0.10***	-0.03	-0.04	-0.002	-0.13**
Exports	6	-0.05***	-0.06	-0.22*	-0.11**	0.04	-0.02	-0.23*	-0.09**
Exports	9	-0.03	-0.24*	-0.14***	-0.21*	0.05	-0.15**	-0.17**	-0.17*
Exports	10	-0.03	-0.07	0.20*	-0.08	0.03	0.04	0.15***	-0.06
Exports	11	-0.10*	0.11	-0.17	-0.07	0.03	0.12	-0.18***	-0.04
Exports	12	-0.15*	-0.02	-0.14***	-0.15*	-0.003	-5.1E-06	-0.10	-0.09**
Constant		0.03*	-0.02***	-0.01	0.02*	0.0003	-0.01	-0.005	0.01
Dummy-1		-0.11*		0.05	-0.005			0.05	
Dummy-2			0.04			0.04*	0.03		0.02
R^2		0.98	0.95	0.95	0.98	0.93	0.93	0.95	0.98

Note: **, **, and *** indicate significance level ate one, five and ten percent respectively*

Table 19
Estimates of FOREX Model

Variables	Lags	Real Exchange Rate				Nominal Exchange Rate			
		Pak-US	Pak-UK	Pak-Euro	Pak-Japan	Pak-US	Pak-UK	Pak-Euro	Pak-Japan
Exchange Rate	1	-0.15	-0.44***	-0.60*	-0.42	-0.50	-0.65*	-0.67*	-0.56***
Exchange Rate	2	-0.33	-0.73*	-0.09	-0.25	-1.06***	-0.92*	-0.23	-0.22
Exchange Rate	3	-0.38	-0.74*	-0.27	-0.14	-0.90*	-1.30*	-0.44**	-0.01
Exchange Rate	4	-0.37***	-0.56**	-0.24	-0.36	-0.70*	-1.09*	-0.53*	-0.32
Exchange Rate	5	-0.17	-0.51***	-0.13	-0.38	-1.24**	-0.95*	-0.31	-0.40
Exchange Rate	6	-0.17	-0.72*	-0.05	-0.18	-1.04***	-1.39*	-0.15	-0.20
Exchange Rate	7	-0.33	-0.72*	0.02	-0.41	-1.33**	-1.18*	-0.01	-0.70
Exchange Rate	8	-0.09	-0.38	0.10	-0.02	-0.99	-0.88*	0.25	-0.20
Exchange Rate	9	-0.05	-0.51***	0.25	0.20	-0.69	-0.75**	0.39	0.01
Exchange Rate	10	-0.25	-0.27	-0.08	-0.07	-0.61***	-0.43***	0.02	-0.24
Exchange Rate	11	-0.32***	-0.12	0.22	-0.09	-0.50***	-0.22	0.37***	-0.25
Exchange Rate	12	-0.17	0.06	0.49**	-0.18	-0.37	0.15	0.52***	-0.56
FOREX Reserves	1	0.03	-0.19**	-0.24*	-0.13	0.09	-0.40*	-0.46*	0.09
FOREX Reserves	2	0.07	0.14	0.16	0.02	0.10**	0.08	0.01	0.07
FOREX Reserves	3	0.00	-0.18	-0.10	0.05	0.02	-0.28**	-0.09	0.12
FOREX Reserves	4	0.00	-0.03	-0.10	0.06	-0.01	-0.07	-0.08	0.07
FOREX Reserves	5	-0.05	0.08	-0.04	0.09	-0.02	0.16	0.12	0.01
FOREX Reserves	6	-0.06***	-0.05	-0.08	0.01	0.04***	0.07	0.06	-0.03
FOREX Reserves	7	-0.01	0.01	-0.14**	0.06	0.07***	0.12	-0.04	-0.04
FOREX Reserves	8	0.01	0.25*	0.13***	0.09	0.05**	0.41*	0.19*	0.02
FOREX Reserves	9	-0.01	0.10	0.05	-0.04	0.07***	0.28*	0.04	-0.01
FOREX Reserves	10	0.02	0.17***	-0.10	-0.04	0.05***	0.32*	-0.12	0.05
FOREX Reserves	11	0.04	0.07	-0.07	-0.05	0.07*	0.18**	-0.12	0.06
FOREX Reserves	12	0.02	0.02	0.04	-0.02	0.04**	0.12***	0.01	0.06
Constant		0.01**	-0.06*	0.01	0.00	0.00***	-0.14*	0.00	-0.04
Dummy-1		-0.08**				-0.20**	0.10	0.13***	-0.10
Dummy-2			0.09*	0.10*	0.04	-0.07***	0.15*	0.10*	0.06
$\mathbf{R^2}$		0.79	0.82	0.81	0.67	0.89	0.86	0.82	0.76

Note: **, **, and *** indicate significance level ate one, five and ten percent respectively*

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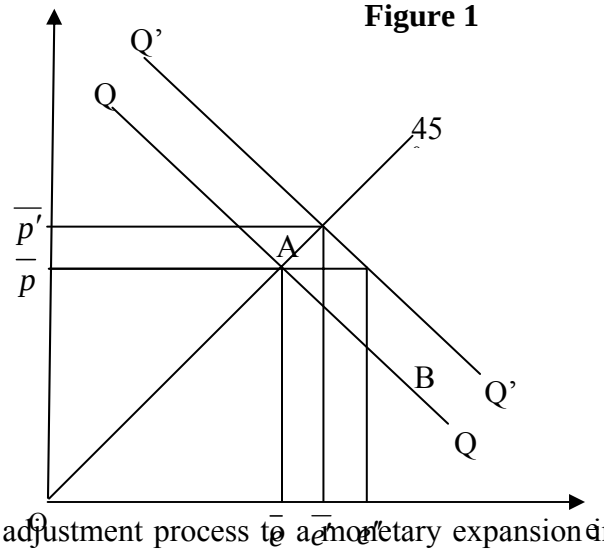
Appendix

Dornbusch Model

We can explain the Dornbusch model with the help of following Figure 1[19]. The initial equilibrium is at point A where the asset market curve QQ is intersecting with 45^0 line from origin. The long run equilibrium prices and exchange rate are $\bar{p}$ and $\bar{e}$ respectively. Increase in the nominal money supply causes disequilibrium in the goods and asset market and reduces the interest rates at the given exchange rate and prices. The reduction in the interest rates results in the capital outflow and depreciation in spot exchange rate but prices still remains constant as shown by point B. The extent of depreciation is more than what it should be, this phenomenon is known as overshooting of exchange rate[20]. However, in the long run, PPP holds, the increase in money supply matched with the increase in prices and exchange rate appreciation after initial depreciation, this is shown by the shift of the asset market curve from QQ to $Q'Q'$ [21]and the new equilibrium restores at point C where exchange rate is at $\bar{e}'$ and prices increase to $\bar{p}'$. This is long run homogeneous result when there is no source of money illusion or long run price rigidity in the system.

Figure 1



The adjustment process to a monetary expansion in this theory has three aspects (see Dornbusch, 1976) First, in the short run, a monetary expansion induces immediate depreciation in the exchange rate. Second, during the adjustment process, rising prices may be accompanied by an appreciating exchange rate. Third, the adjustment process is a direct effect of the exchange rate on domestic inflation. In this context the exchange rate is identified as a critical channel for the transmission of money to aggregate demand for domestic output.

Unit Root Tests

Two tests are generally employed by the researchers which are briefly given below

[19] Tthis is taken from original Dornbusch (1976) article
[20] Dornbusch model is also known as overshooting model.
[21] This shift is exactly proportional to increase in money supply.

ADF Test

In the ADF test the form equation may be either of the two forms,

$$\Delta y_t = \alpha + \beta y_{t-1} + \gamma t + \sum_{i=2}^{p} \delta_i \Delta y_{t-i+1} + \varepsilon_t \quad \text{(III.6a)}$$

$$y_t = \alpha + \rho y_{t-1} + \gamma t + \sum_{i=2}^{p} \delta_i \Delta y_{t-i+1} + \varepsilon_t \quad \text{(III.6b)}$$

These equations can be estimated with and without intercept or trend or both. Maddala and Kim (1998) state that the size and the power of ADF test is too sensitive to number of lag lengths[22]. However, with the use of Akaike Information Criteria (AIC) or Schwarz Bayesian Criteria (SBC) we can check the appropriate lag lengths. AIC and SBC criteria can be represented by the following equations,

$$AIC = T \log|\Sigma| + 2N \quad \text{(III.7)}$$

$$SBC = T \log|\Sigma| + N \log(T) \quad \text{(III.8)}$$

where Σ represents the determinant of the variance/covariance matrix of the residuals, N represents the total number of parameters estimated in all equations, and T represents the number of used observations in the regression. Minimum value of criterion is the indication that the model is better/best. Therefore there is a chance that ADF equation might not have any lagged difference variables. But estimating ADF equation without any lagged differences we might end up with problem of serial correlation, therefore lagged differences should be included in the ADF test. In ADF test, our one-tailed null and alternative hypotheses are,

H_O: $\beta = 0$ or $\rho = 1$ (where $\beta = \rho - 1$)

H_A: $\beta \neq 0$ or $\rho \neq 1$

Series is said to be a stationary if null hypothesis is rejected. After checking at the levels we can check by taking first difference of the variable if the series is not stationary at levels. If the first difference is not stationary then we can take the 2nd difference and apply the stationarity test and so on. The test statistic used for the significance of coefficient is McKinnon τ-values[23].

Advantages of SVAR

- It captures rich dynamic relationship between the variables
- No needs to put restrictions
- Dynamic relationship can be checked using impulse response function and variance decomposition
- It is a good tool to check causality
- There is no simultaneity as well as identification problem

Disadvantages of SVAR

- VAR individual coefficients are difficult to interpret

[22] For more details see (Ng and Perron, 1995)

[23] Critical McKinnon τ-values are directly computed by E-Views.

- It is a high dimensional multivariate system and problem of over-parameterisation is always present.

Impulse Response Function (IRF)

Let us consider the first order autoregressive model in the standard form:

$$x_t = A_0 + A_t x_{t-1} + e_t$$

where A_0 is the vector of intercepts to allow the means of x_t to be non-zero and e_t is a white noise. This equation can be represented as the Vector Moving Average (VMA) equation[24].

$$x_t = \mu + \sum_{i=1}^{\infty} A_i^i e_{t-i}$$

VMA is an essential feature, which allows tracing out time paths of the various shocks on the variables contained in the VAR system. In our analysis we can check the impact of various shocks on real exchange rates, real money supply differences and real interest differentials. The VMA can be mathematically written as,

$$\begin{bmatrix} rer_t \\ rid_t \\ rmd_t \end{bmatrix} = \begin{bmatrix} \overline{rer} \\ \overline{rid} \\ \overline{rmd} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \phi_{11}(i) & \phi_{12}(i) & \phi_{13}(i) \\ \phi_{21}(i) & \phi_{22}(i) & \phi_{23}(i) \\ \phi_{31}(i) & \phi_{32}(i) & \phi_{33}(i) \end{bmatrix} \begin{bmatrix} \varepsilon_{rert-i} \\ \varepsilon_{ridt-i} \\ \varepsilon_{rmdt-i} \end{bmatrix}$$

The set of ϕ's is known as impulse response function. The coefficient ϕ_1 at $i = 0$ is the instantaneous impact of one unit change in ε_{rid} on rer_t (Enders, 1995) and similarly, we can say for the other ϕ's.

Properties of IRF:

- The response is linear in the size of shock
- The response of positive and negative shock is symmetric
- Shock will transient if the series is stationary
- If IRF does not die out, shocks have permanent effect

[24] The Details and more elaborate explanation is given in Enders (1995)

APPENDIX A

Figure 1
Pak – US Nominal and Real Exchange Rate

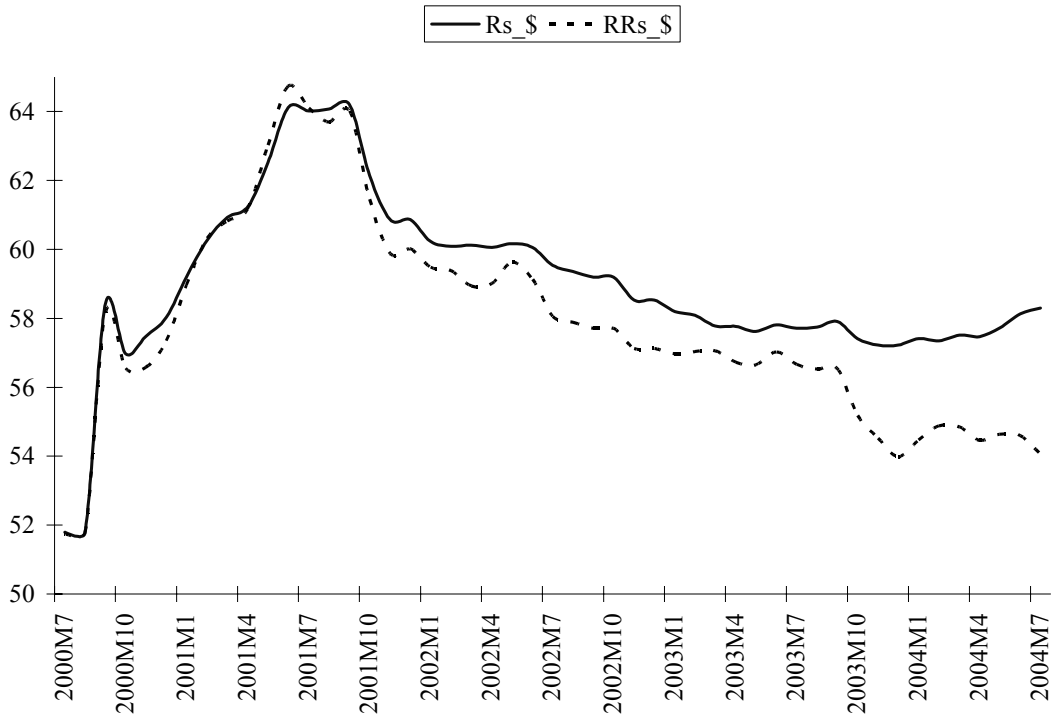


Figure 2
Pak – UK Nominal and Real Exchange Rate

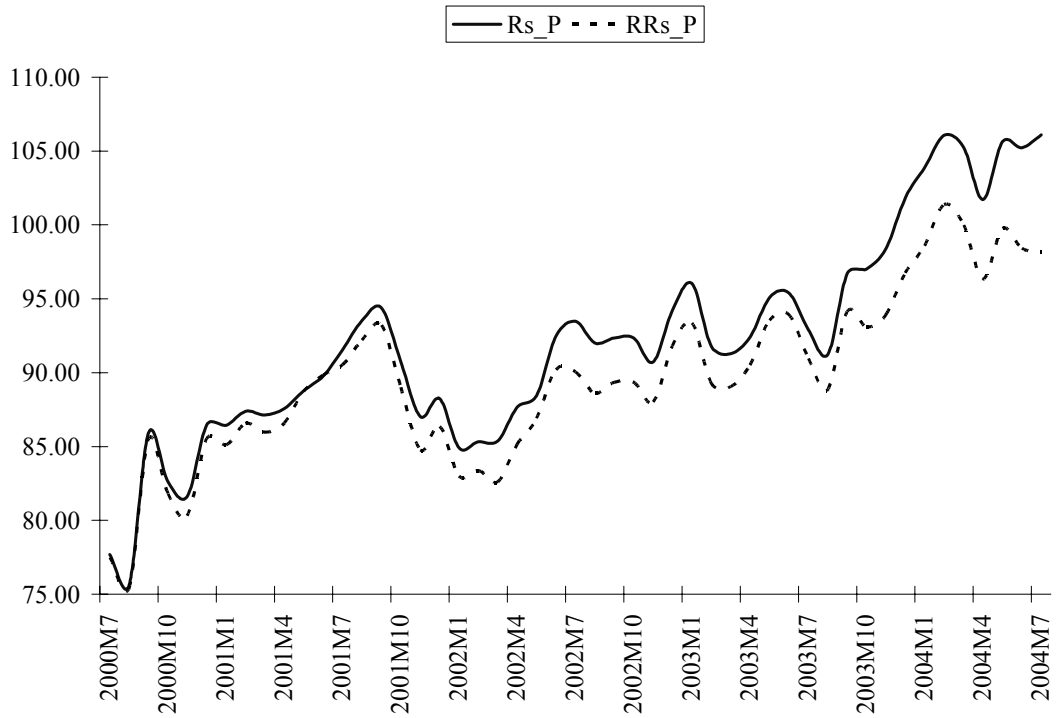


Figure 3
Pak – Euro Nominal and Real Exchange Rate

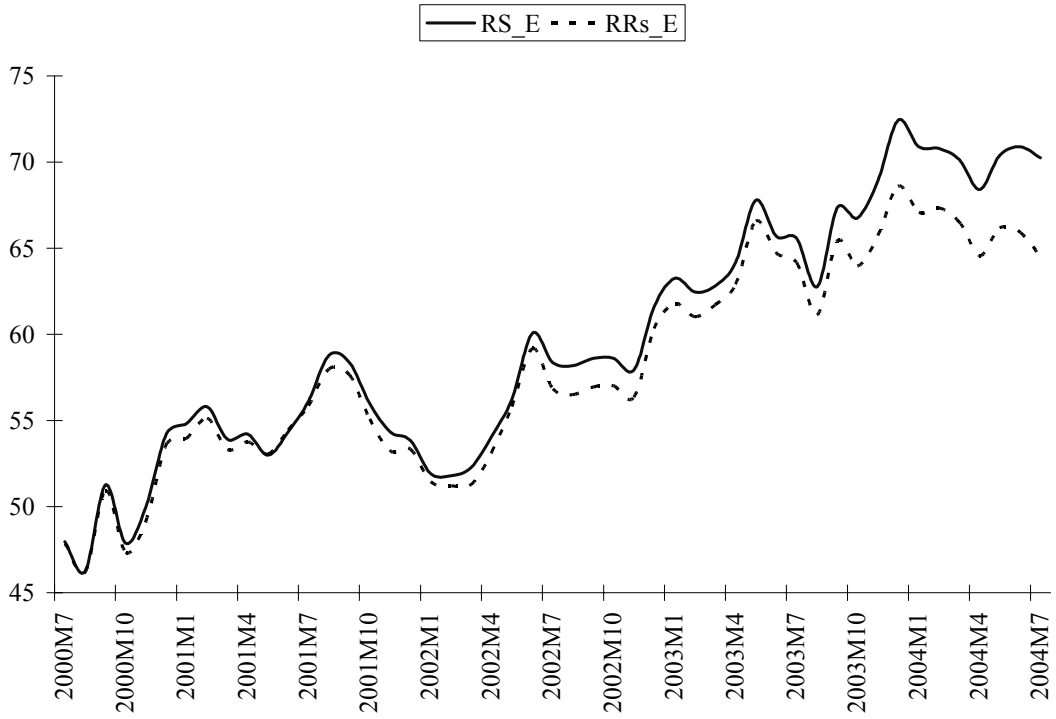


Figure 4
Pak – Japan Nominal and Real Exchange Rate

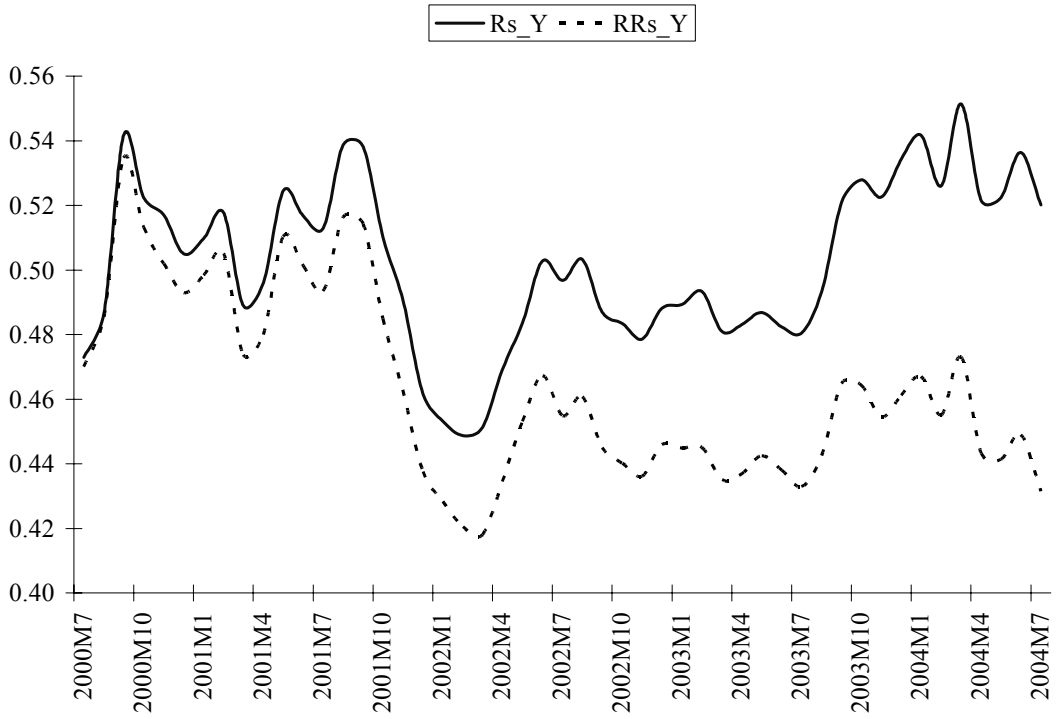


Figure 5
Pak – US nominal exchange rate and Relative Prices

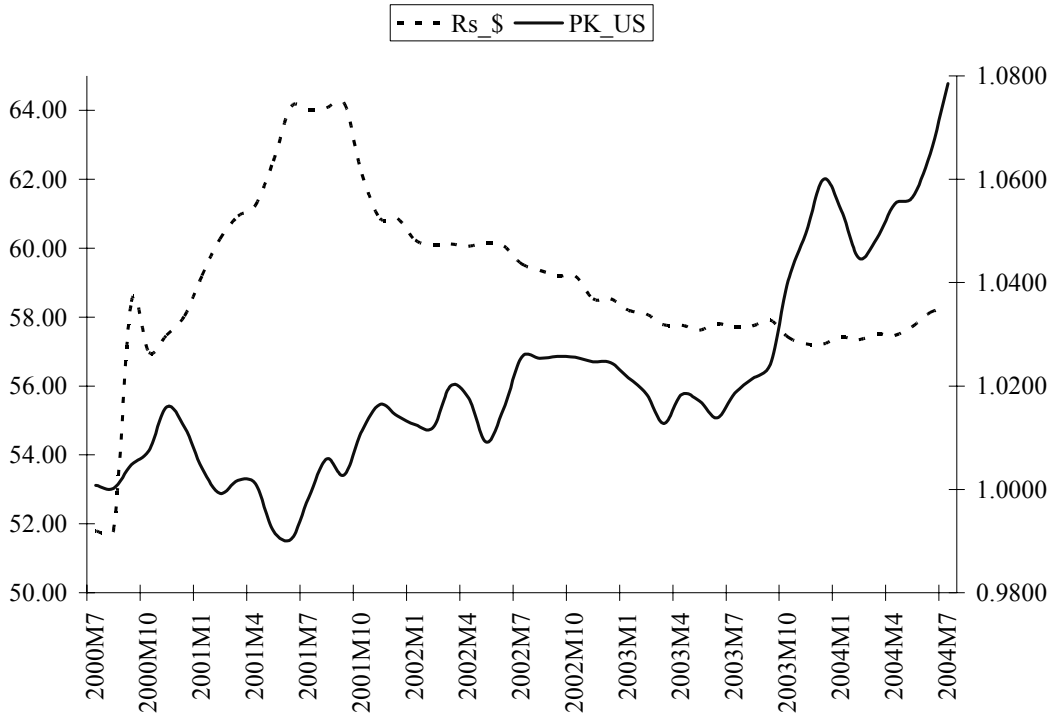


Figure 6
Pak – UK nominal exchange rate and Relative Prices

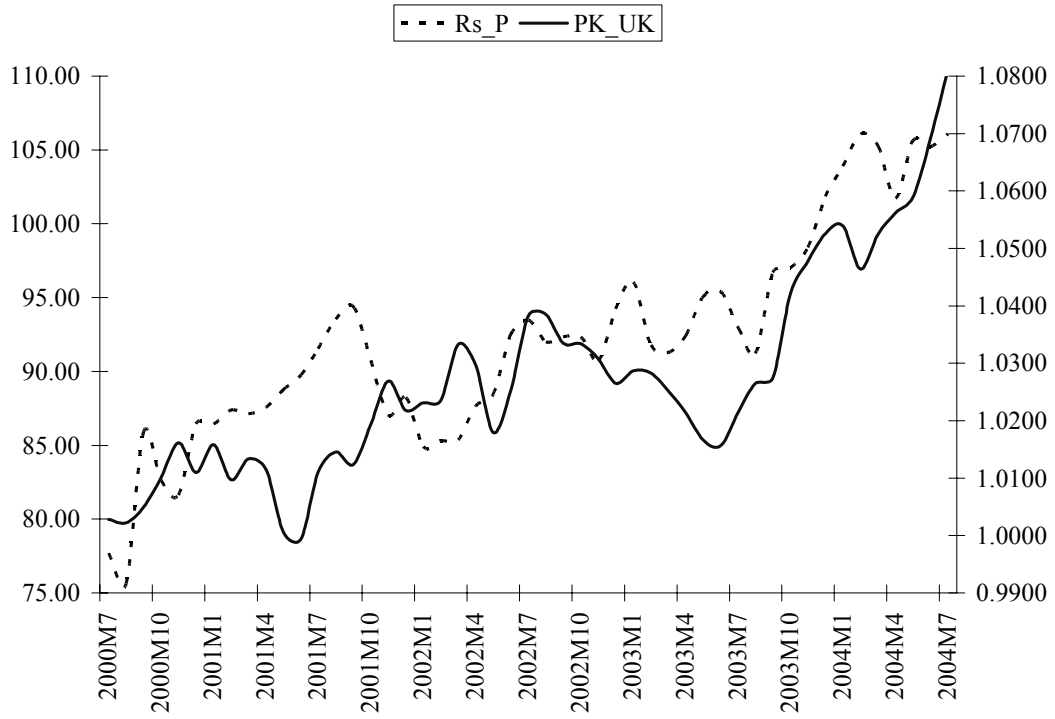


Figure 7
Pak – Euro nominal exchange rate and Relative Prices

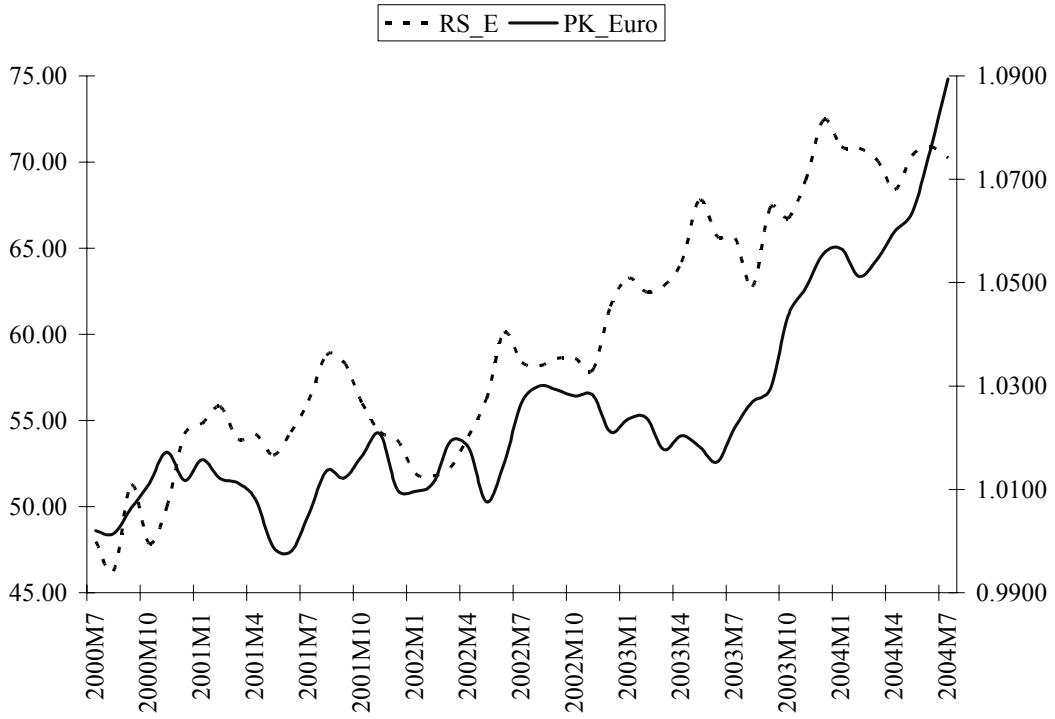


Figure 8
Pak – Japan nominal exchange rate and Relative Prices

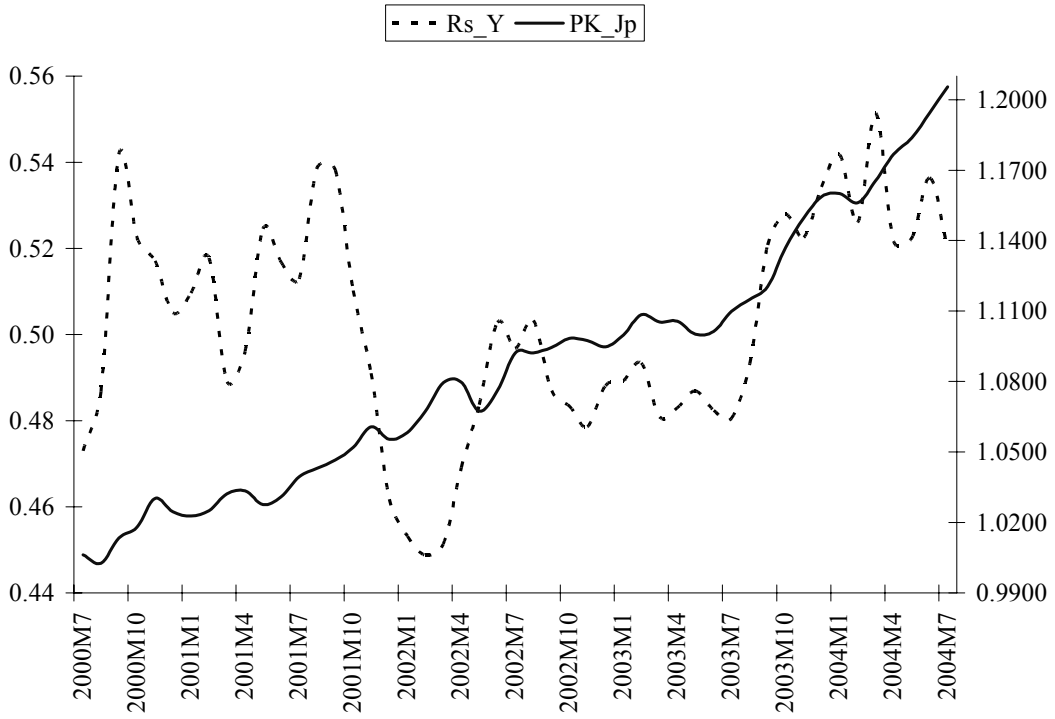


Figure 9
Pak – US Nominal Interest Differential and Nominal Exchange Rate

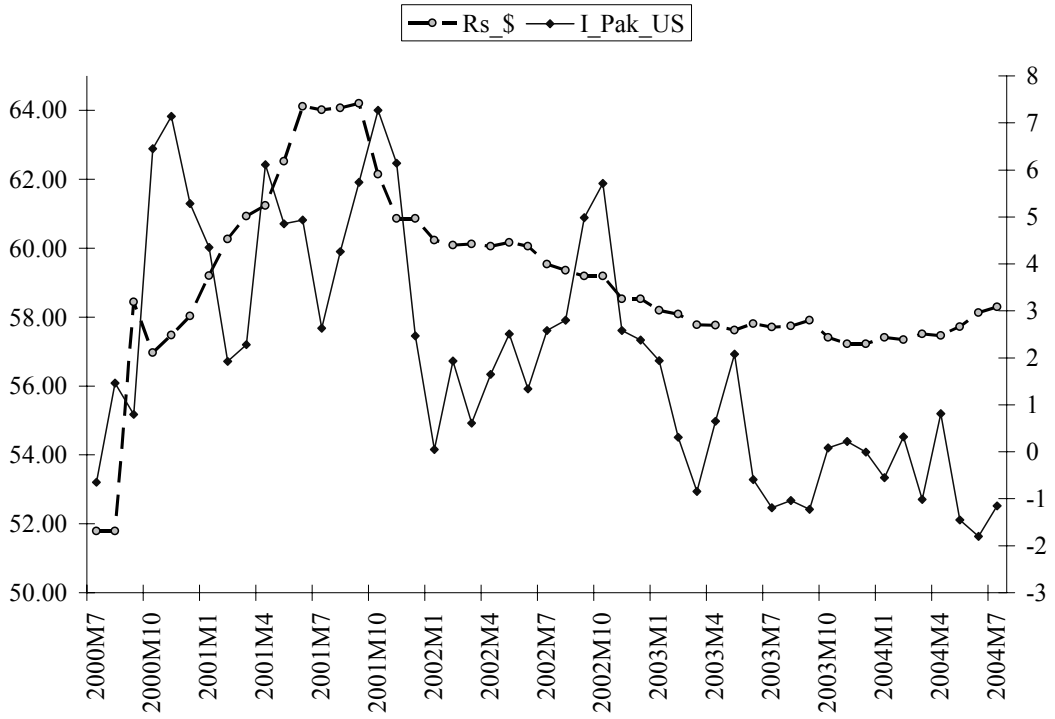


Figure 10
Pak – UK Nominal Interest Differential and Nominal Exchange Rate

Figure 11
Pak – Euro Nominal Interest Differential and Nominal Exchange Rate

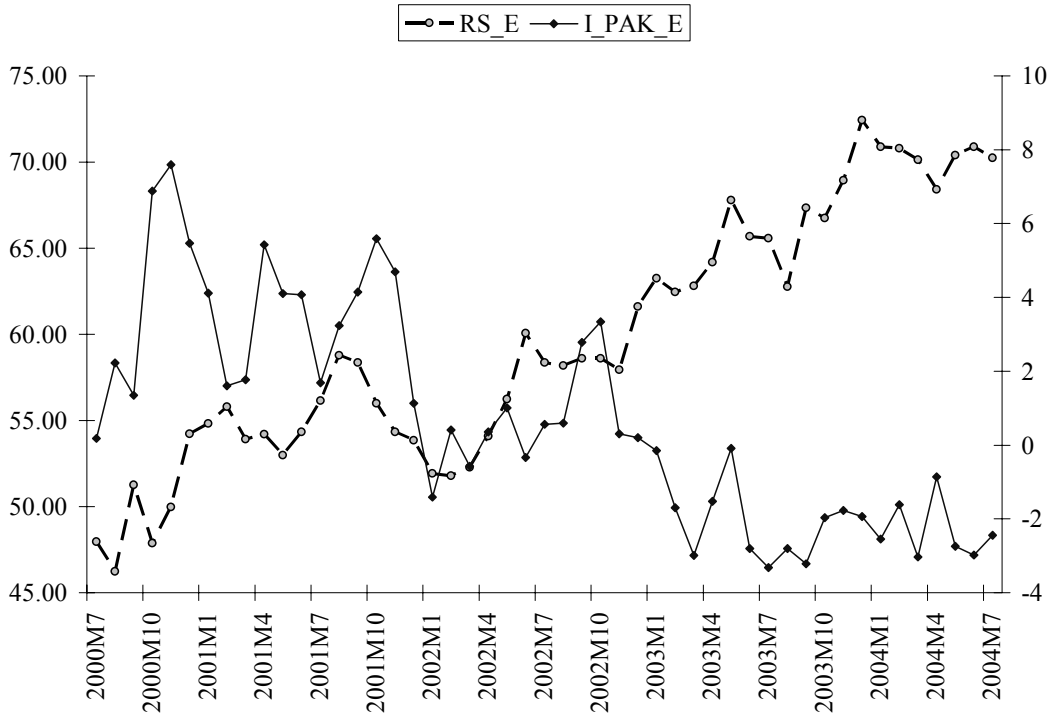


Figure 12
Pak – Japan Nominal Interest Differential and Nominal Exchange Rate

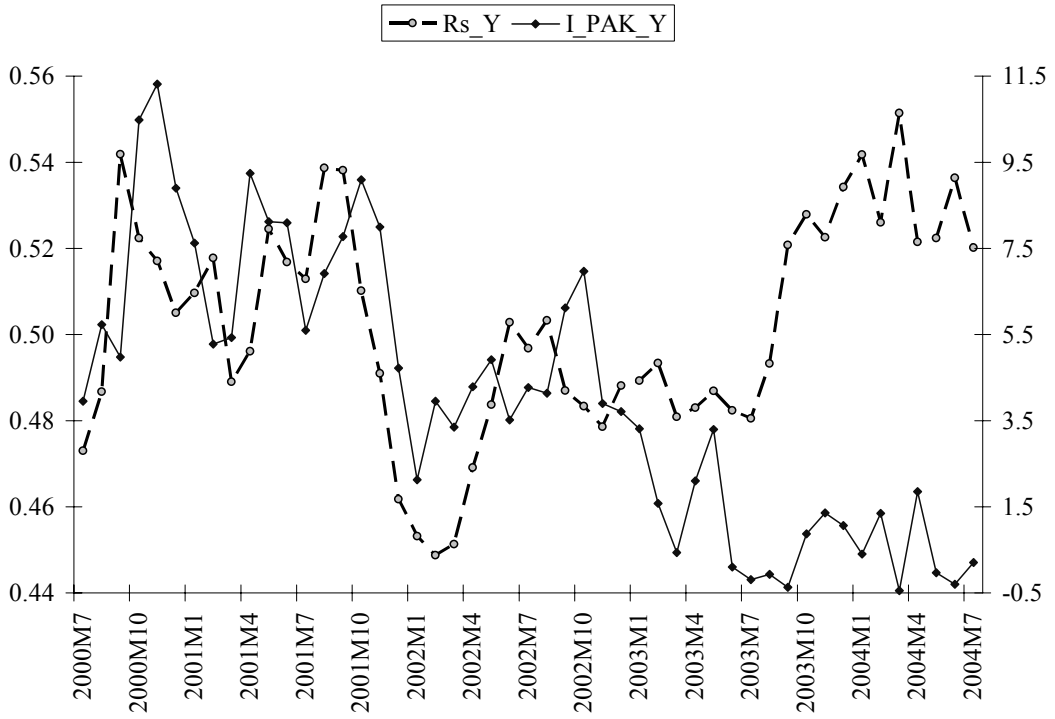


Figure 13
Pak – US Real Interest Differential and Real Exchange Rate

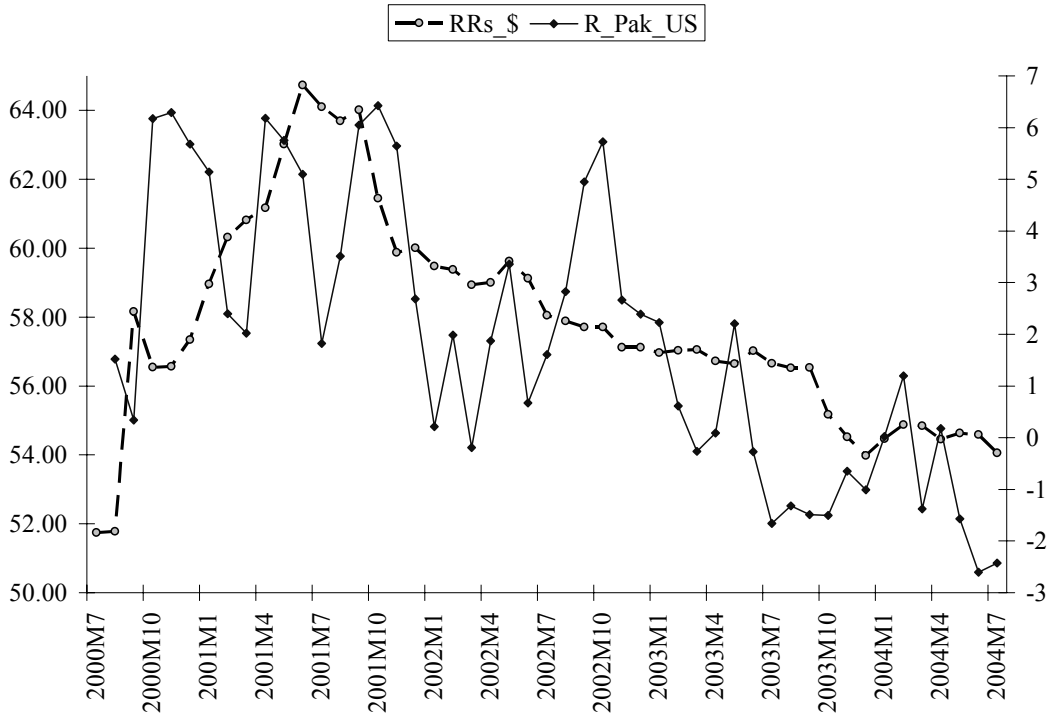


Figure 14
Pak – UK Real Interest Differential and Real Exchange Rate

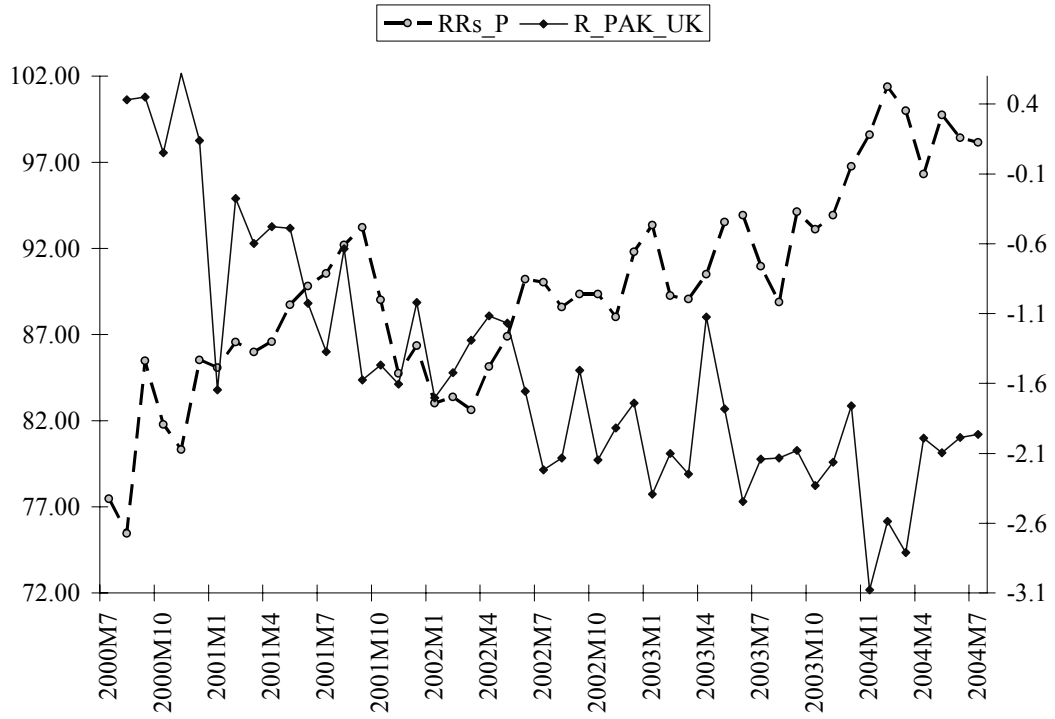


Figure 15
Pak – Euro Real Interest Differential and Real Exchange Rate

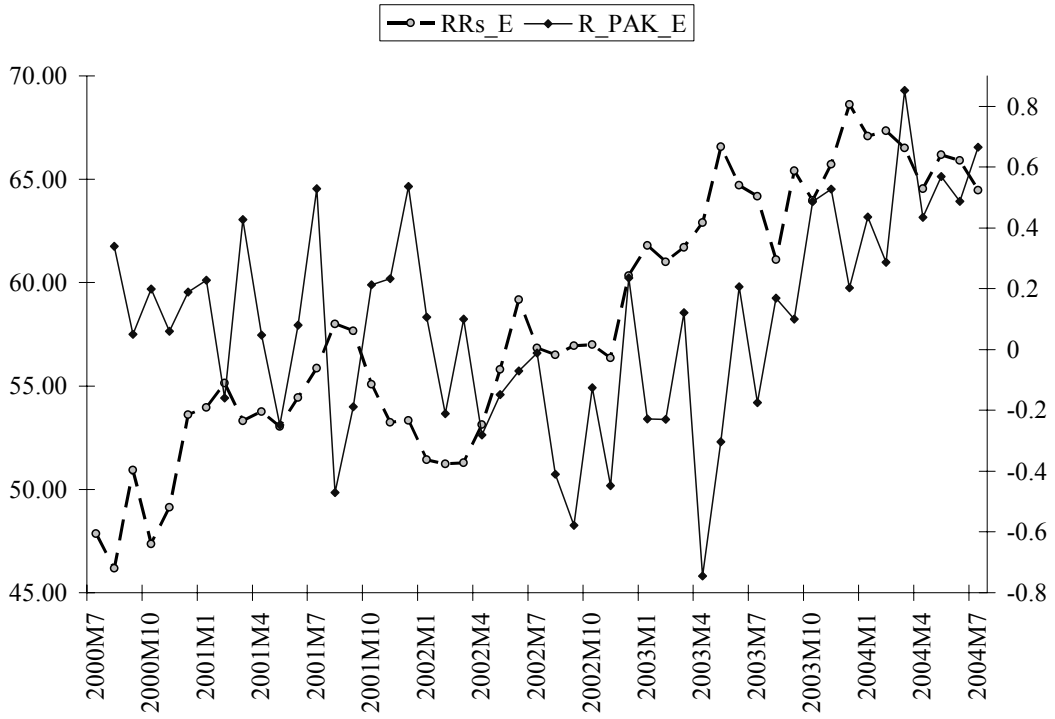


Figure 16
Pak – Japan Real Interest Differential and Real Exchange Rate

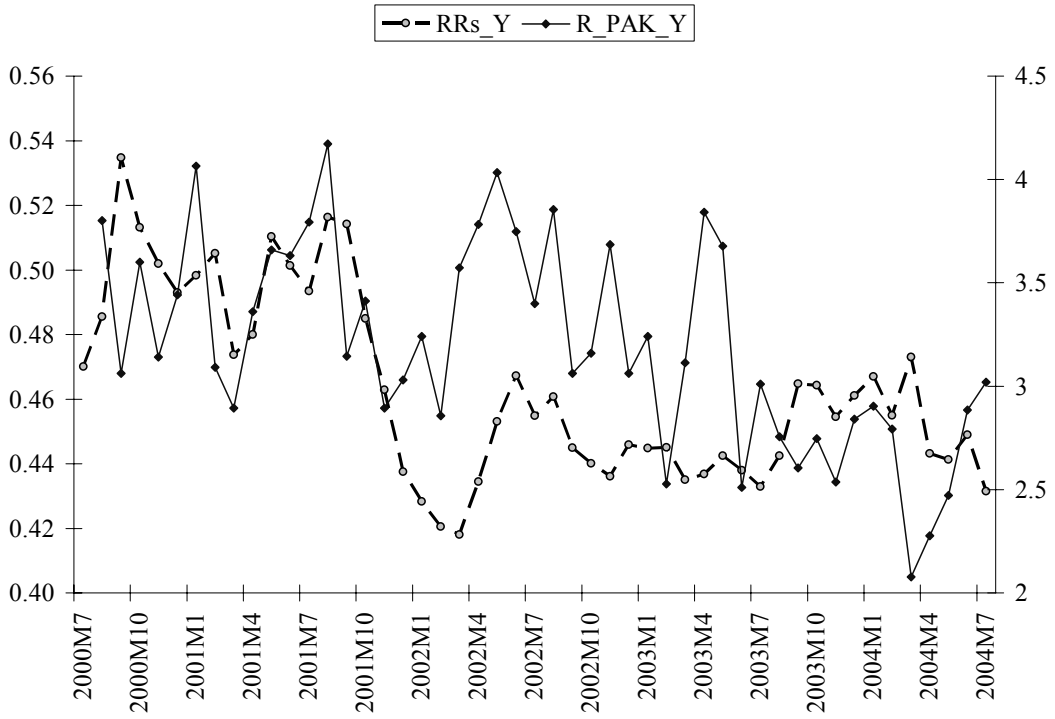


Figure 17
Nominal Money Supply among Pakistan and four other Countries

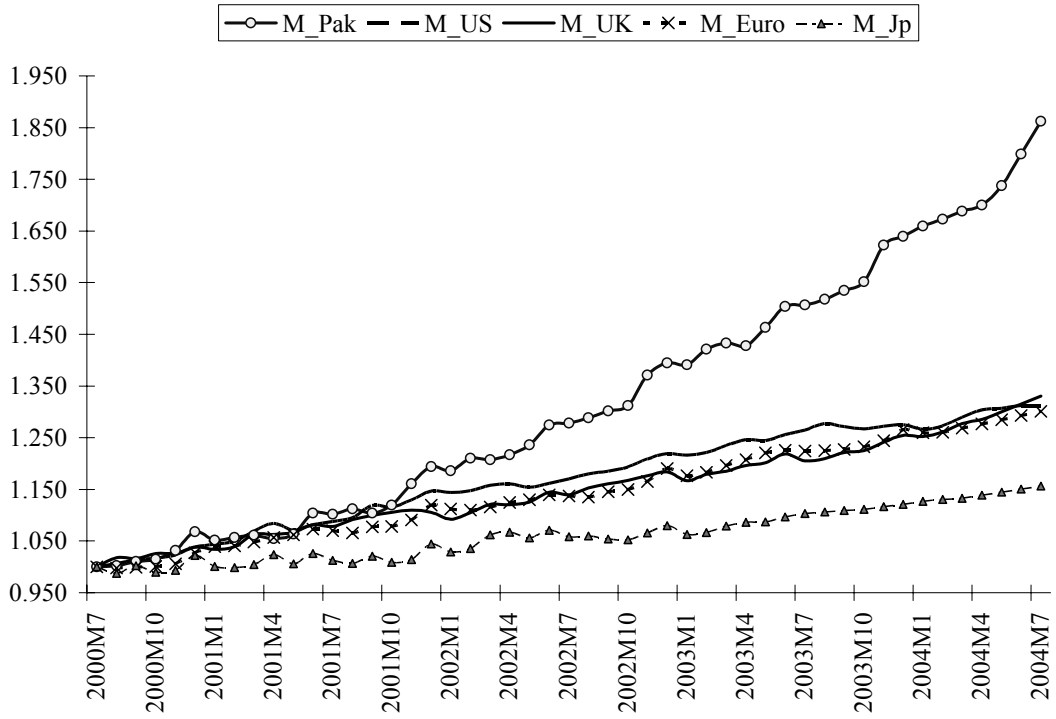


Figure 18
Real Money Supply among Pakistan and four other Countries

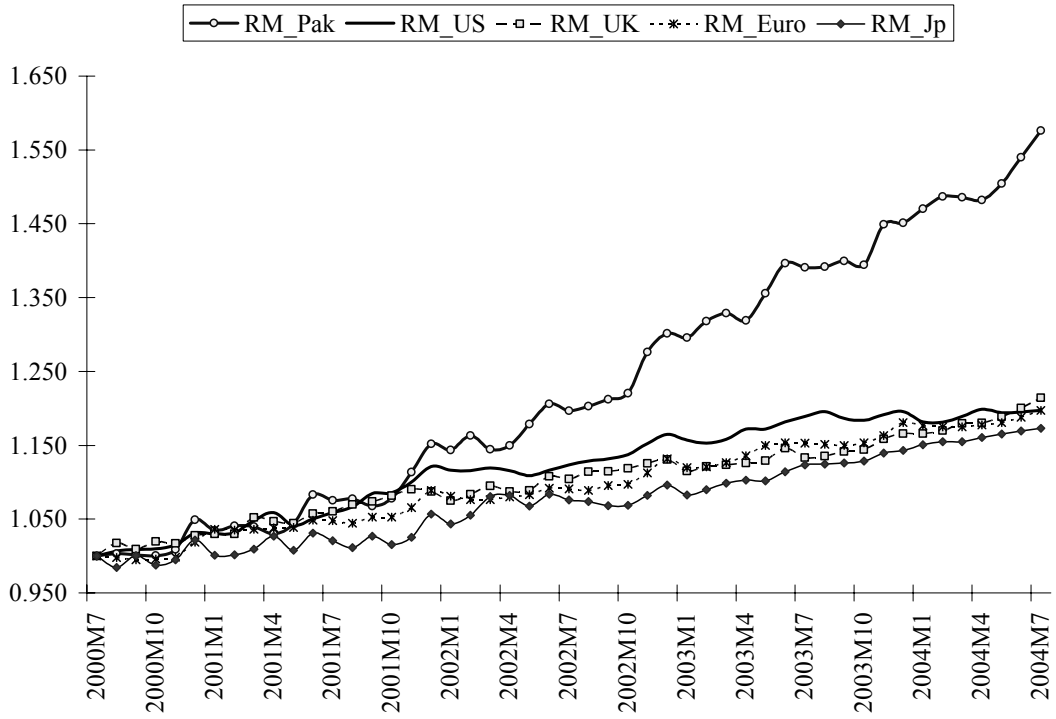


Figure 19
Pak – US Nominal Money Differential and Nominal Exchange Rate

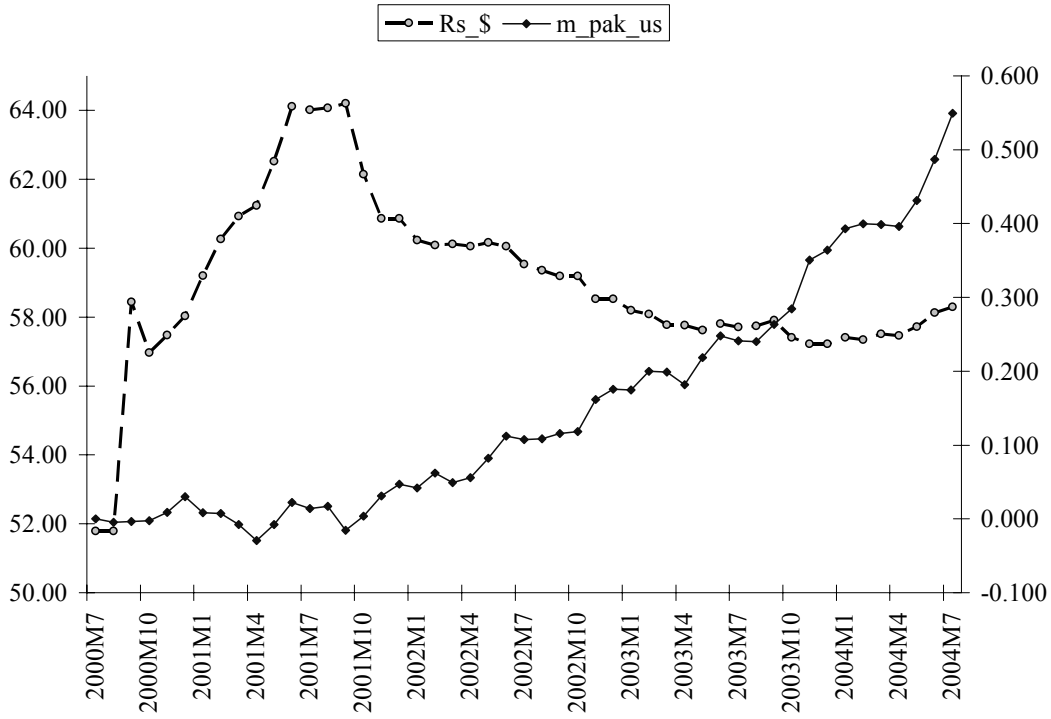


Figure 20
Pak – UK Nominal Money Differential and Nominal Exchange Rate

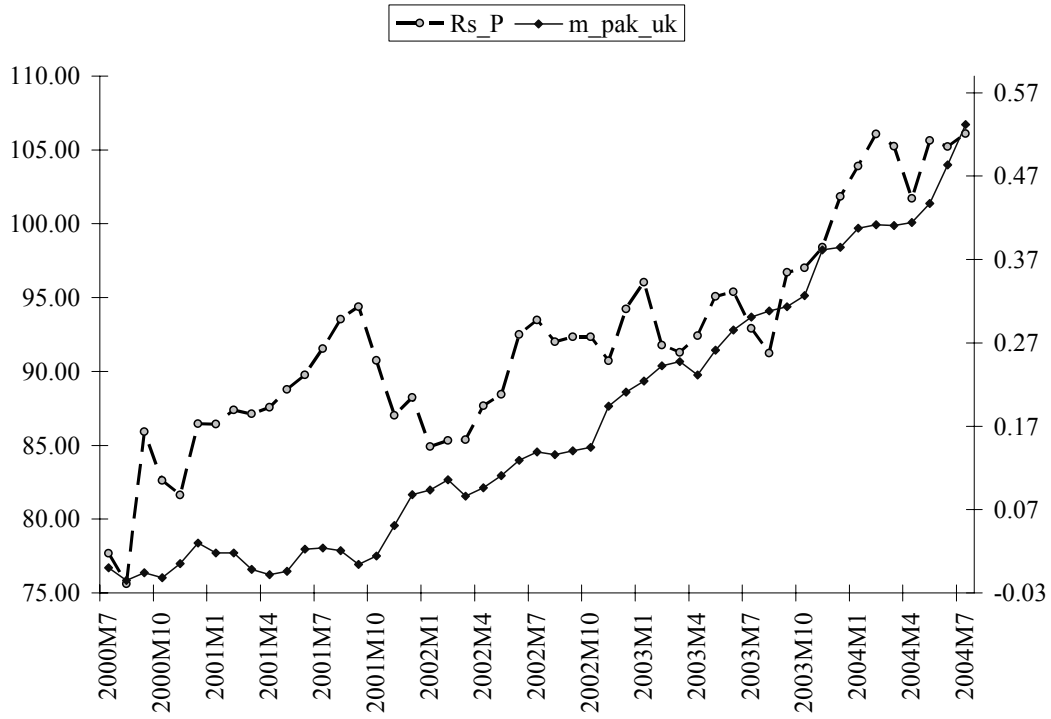


Figure 21
Pak – Euro Nominal Money Differential and Nominal Exchange Rate

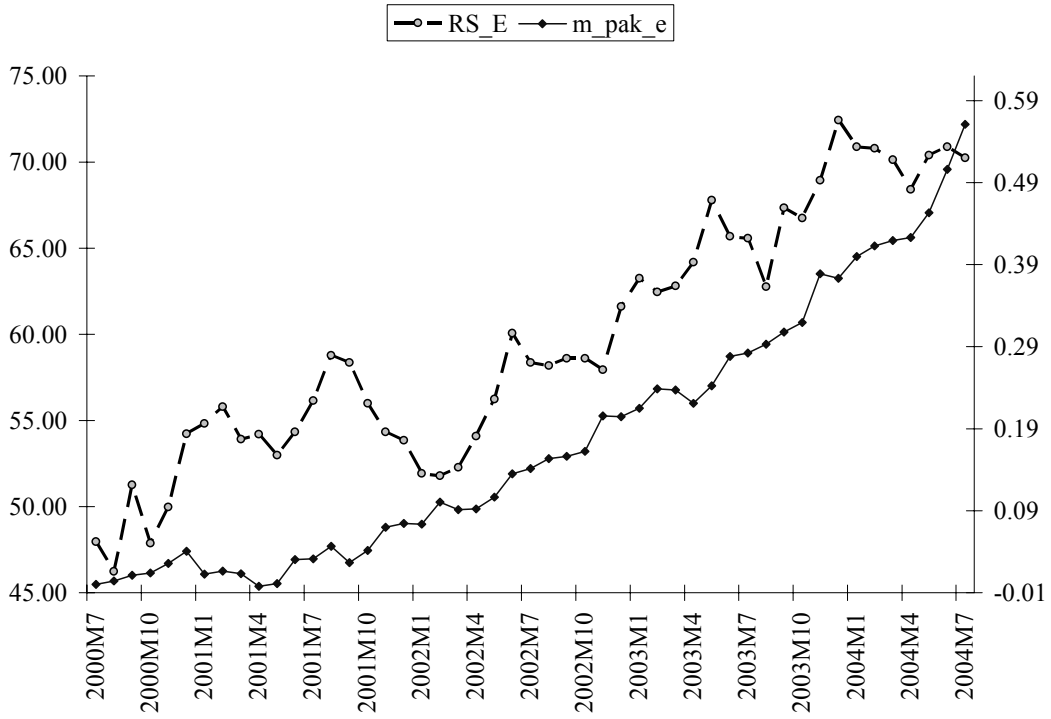


Figure 22
Pak – Japan Nominal Money Differential and Nominal Exchange Rate

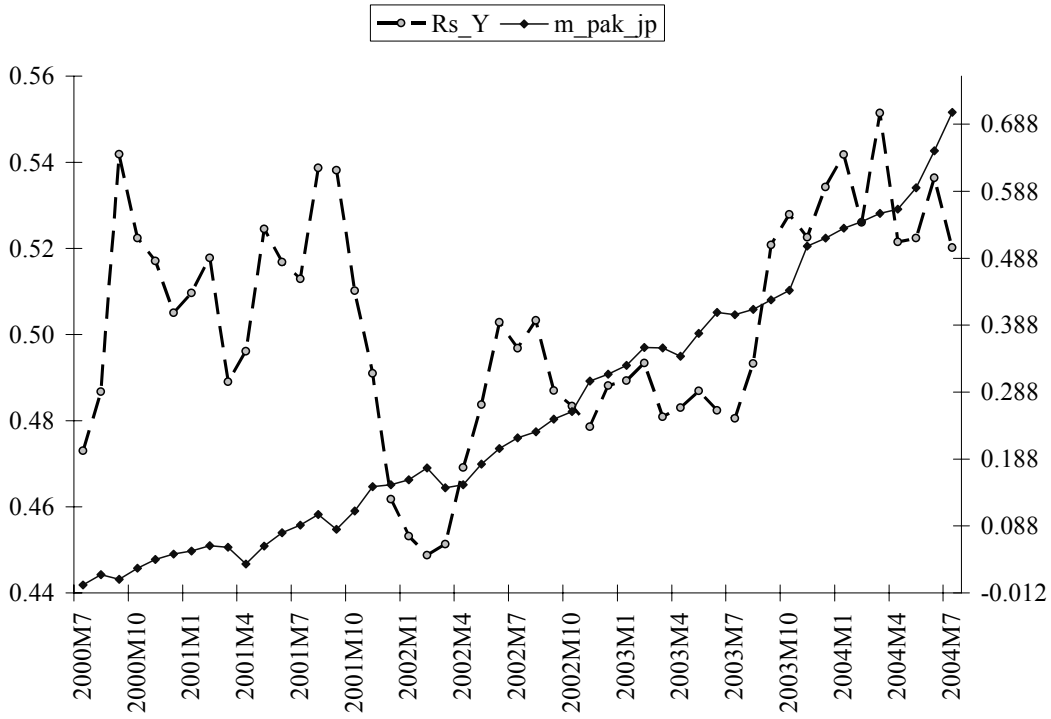


Figure 23
Pak – US Real Money Differential and Real Exchange Rate

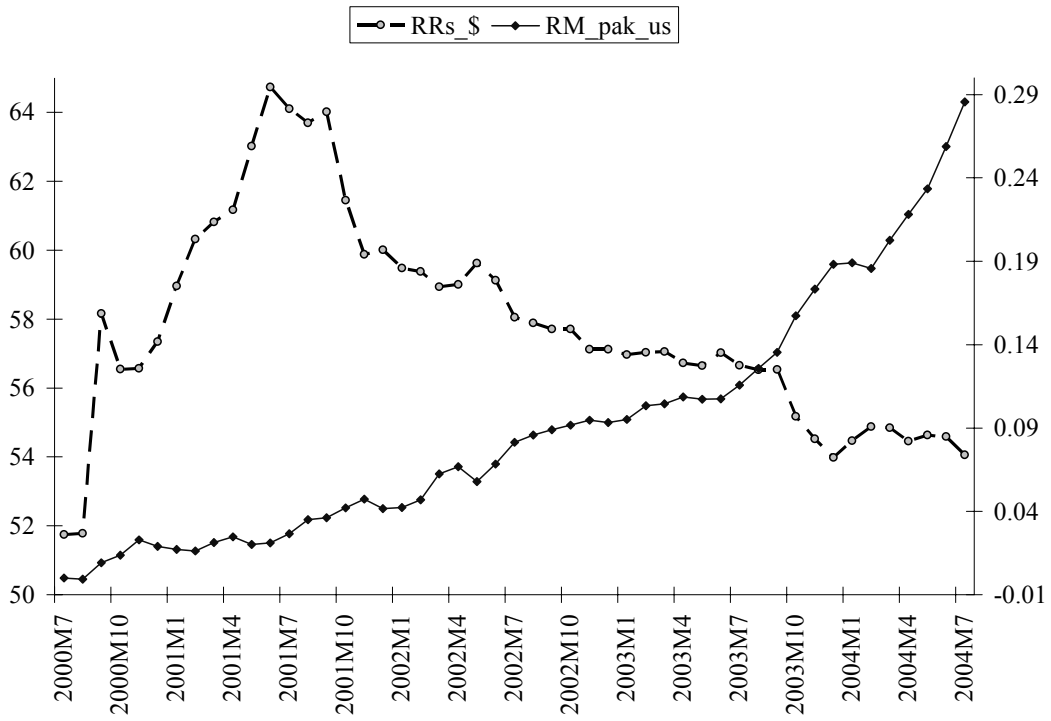


Figure 24
Pak – UK Real Money Differential and Real Exchange Rate

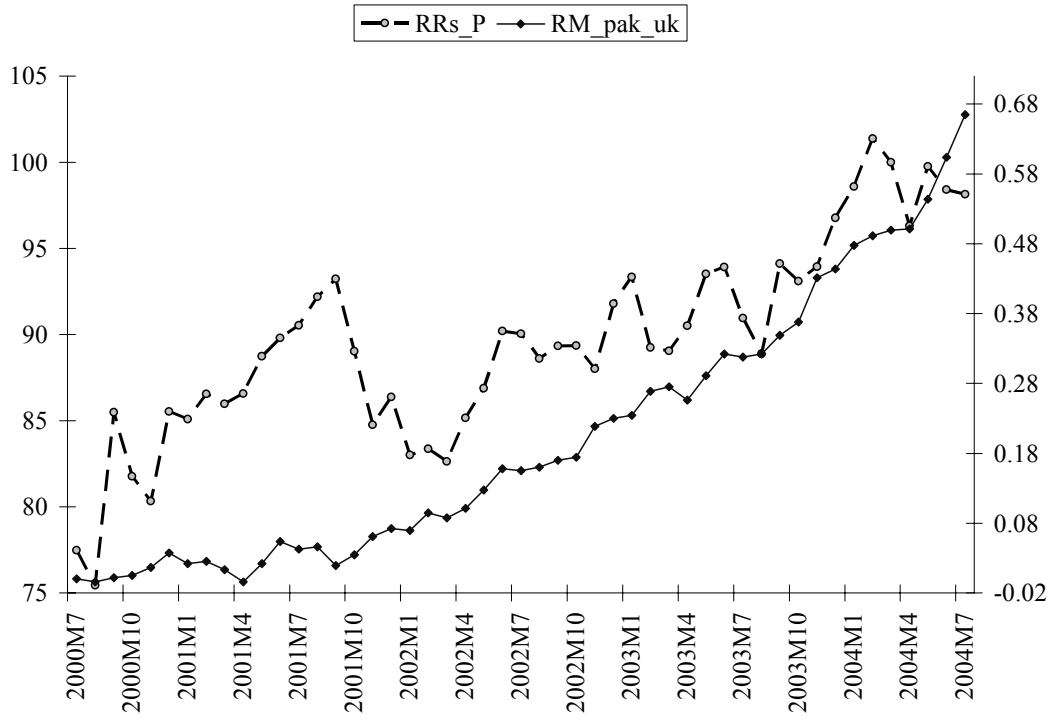


Figure 25
Pak – Euro Real Money Differential and Real Exchange Rate

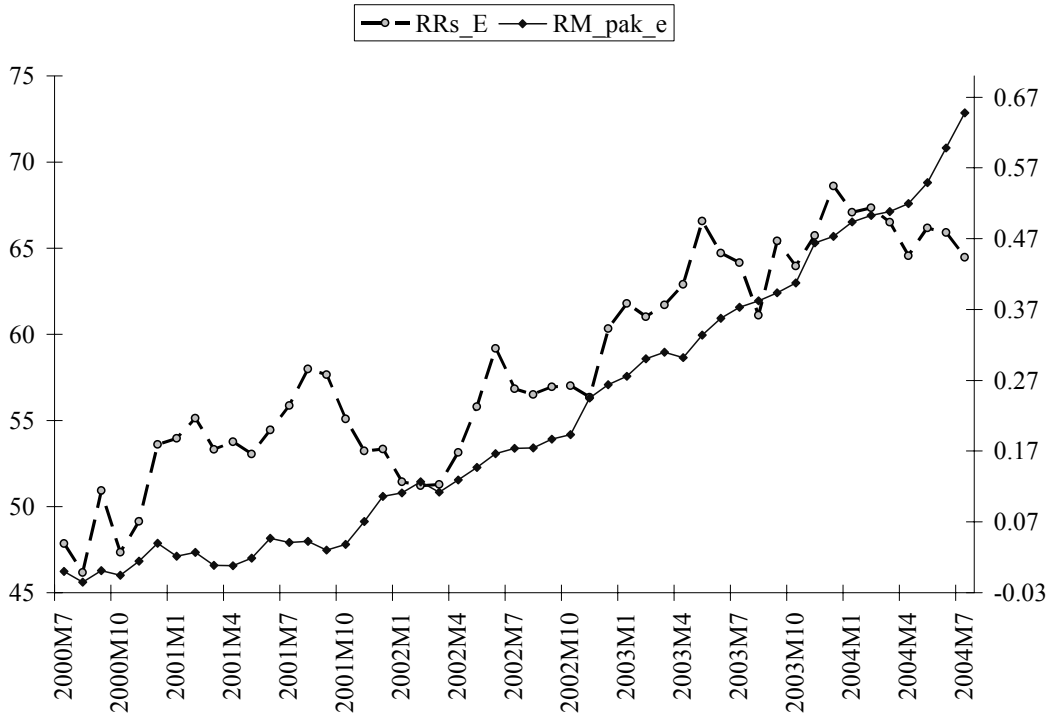


Figure 26
Pak – Japan Real Money Differential and Real Exchange Rate

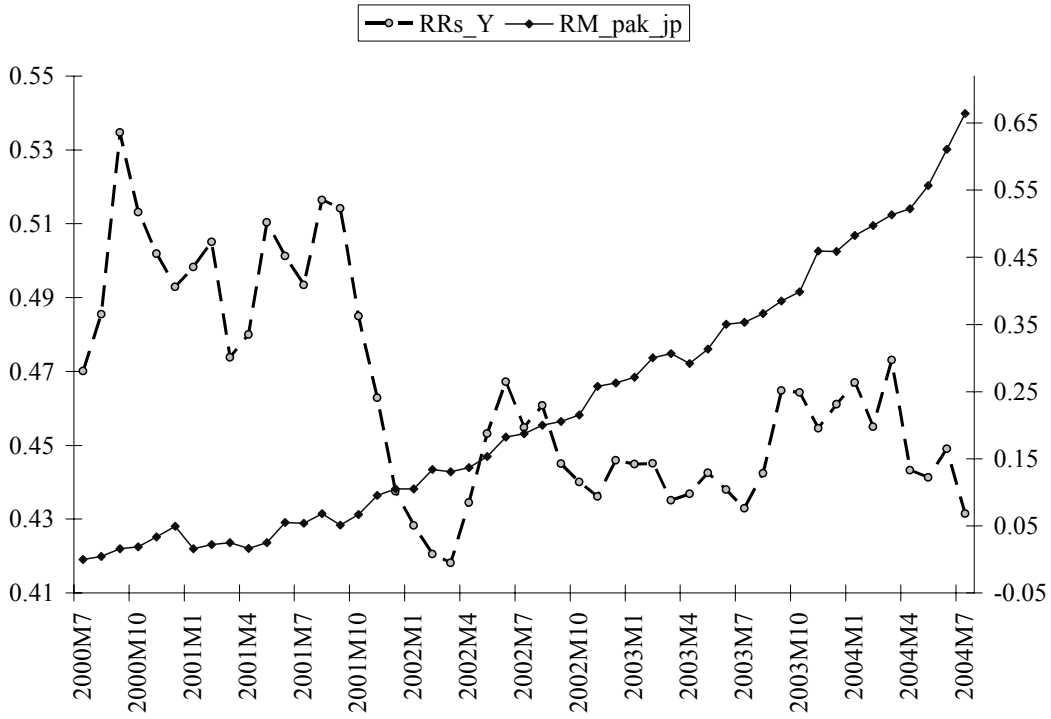


Figure 27
Pak – US Trade Balance and Nominal Devaluation

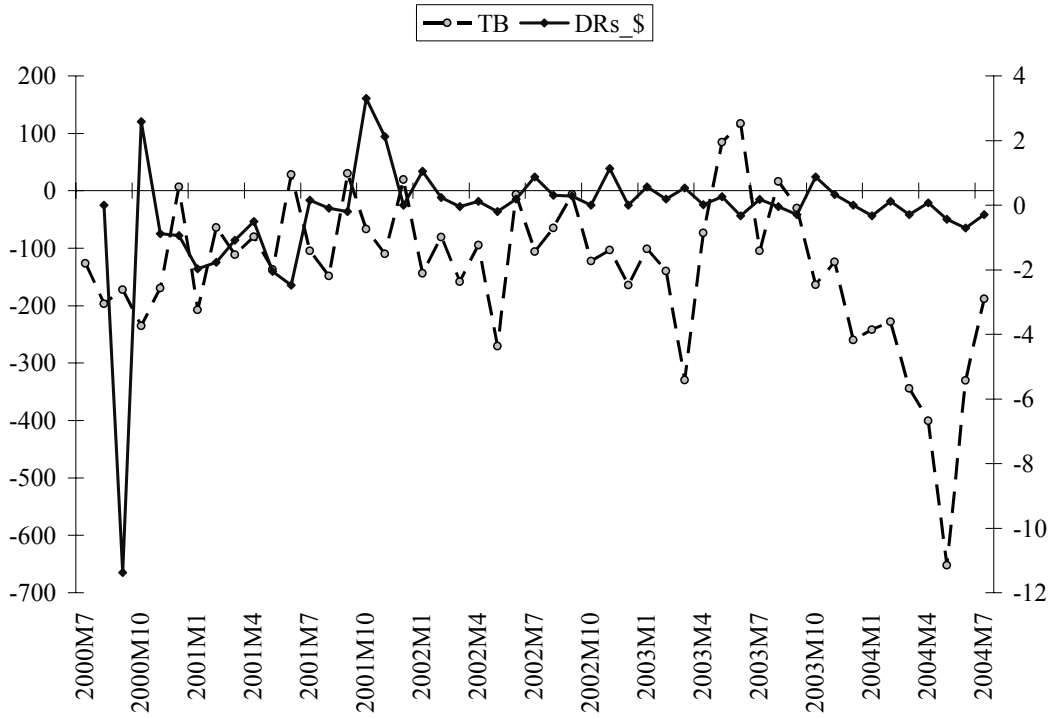


Figure 28
Pak – UK Trade Balance and Nominal Devaluation

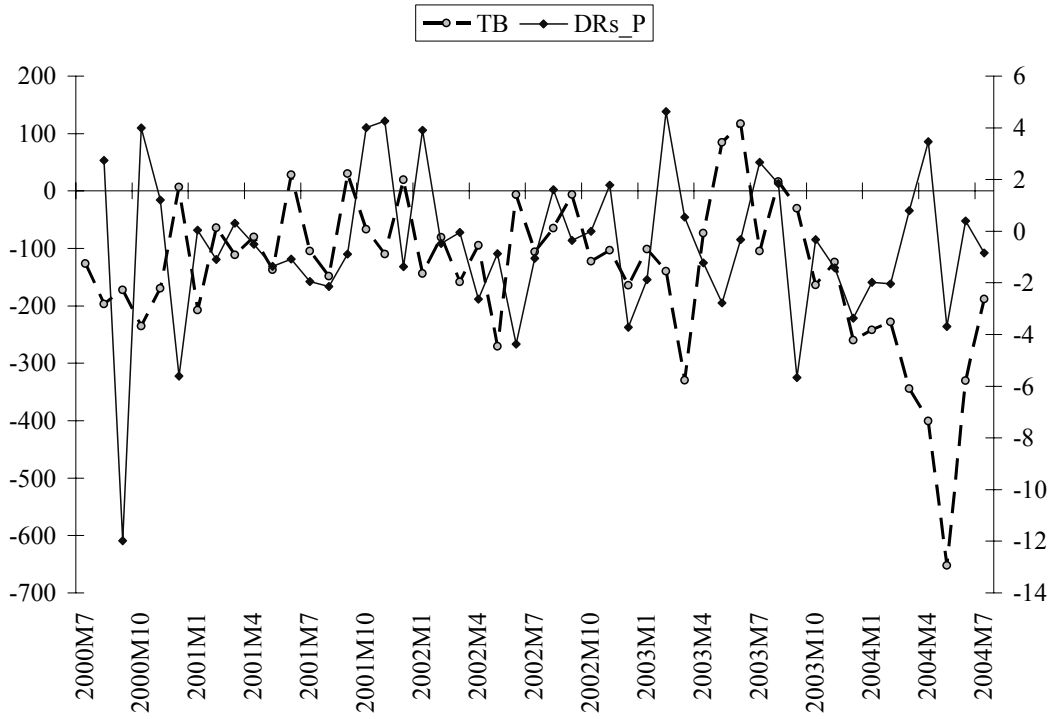


Figure 29
Pak – Euro Trade Balance and Nominal Devaluation

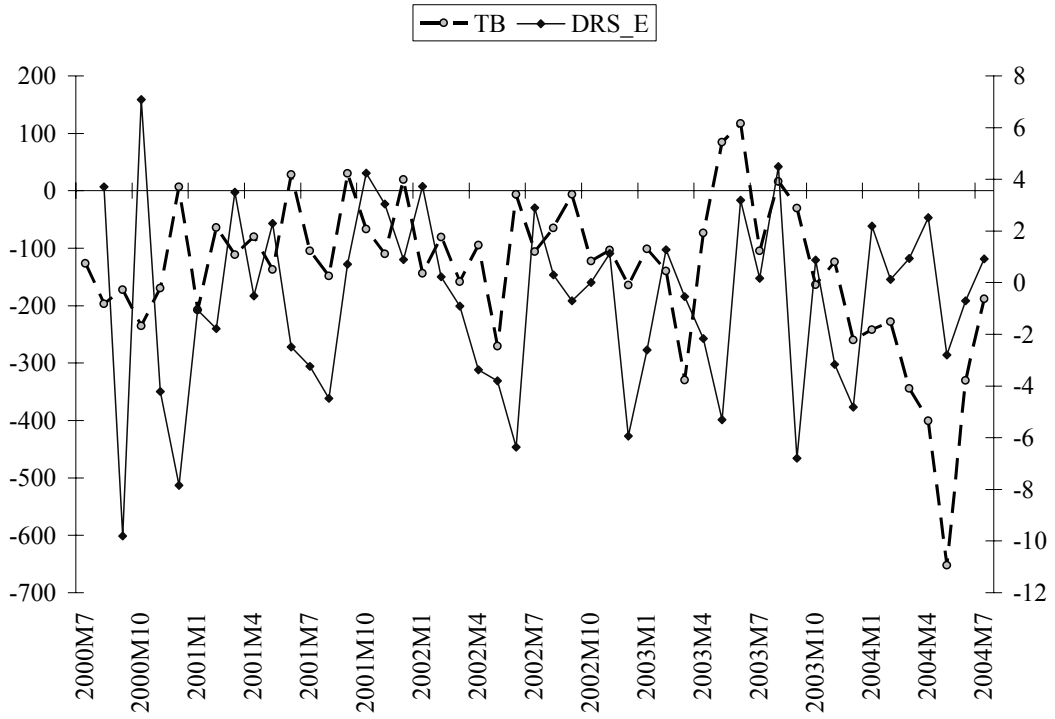


Figure 30
Pak – Japan Trade Balance and Nominal Devaluation

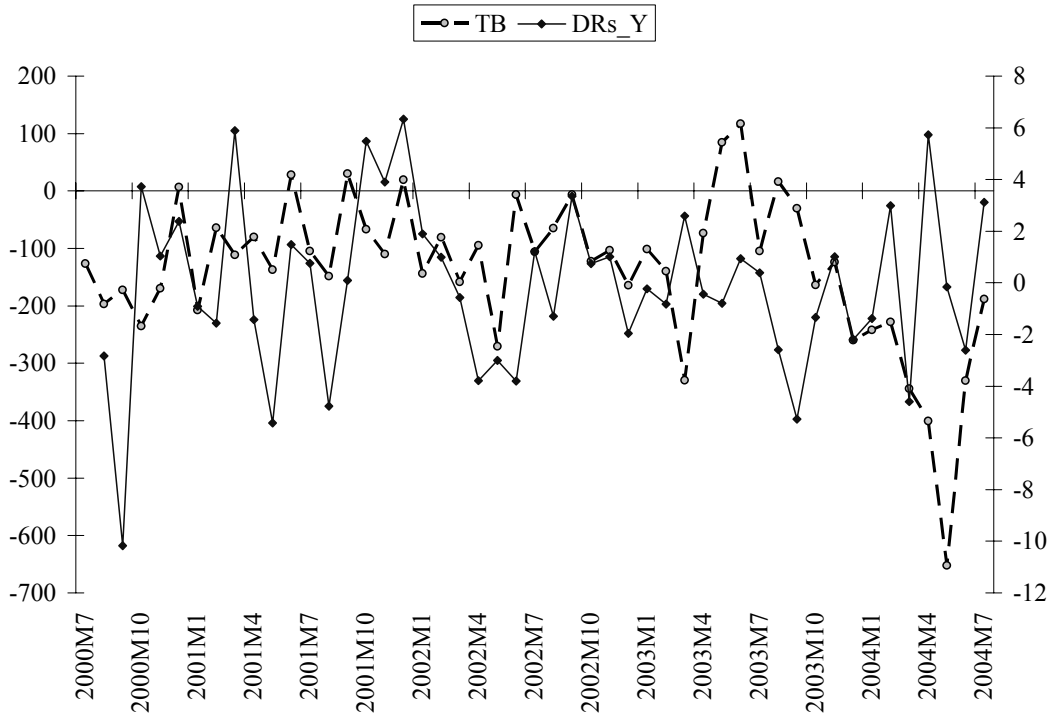


Figure 31
Pak – US Trade Balance and Real Devaluation

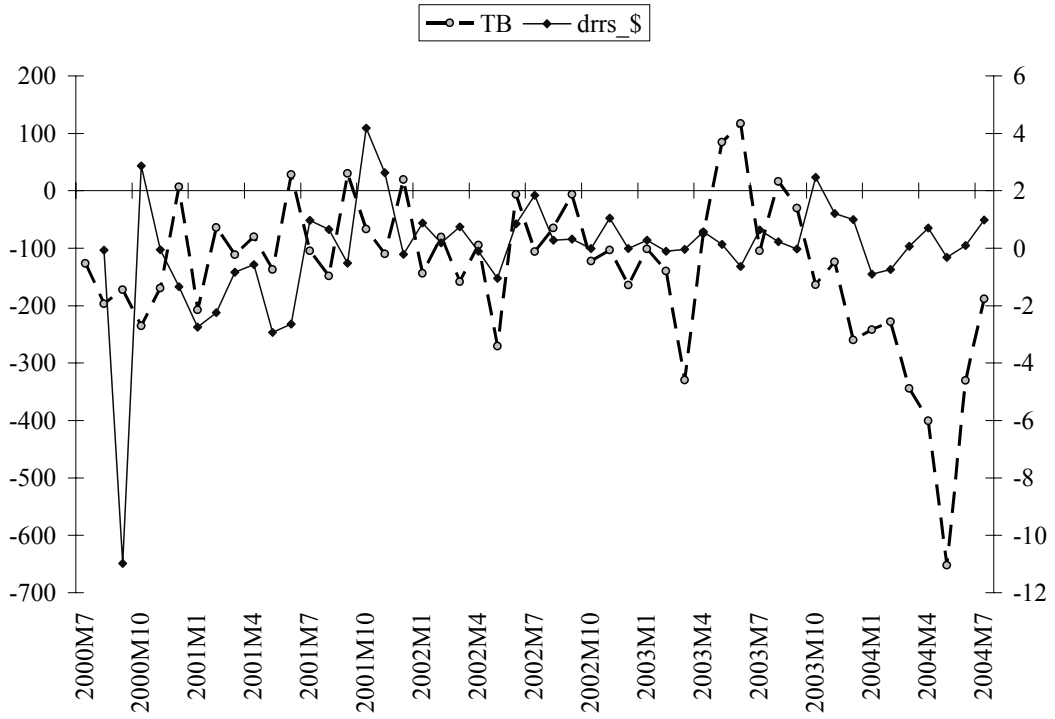


Figure 32
Pak – UK Trade Balance and Real Devaluation

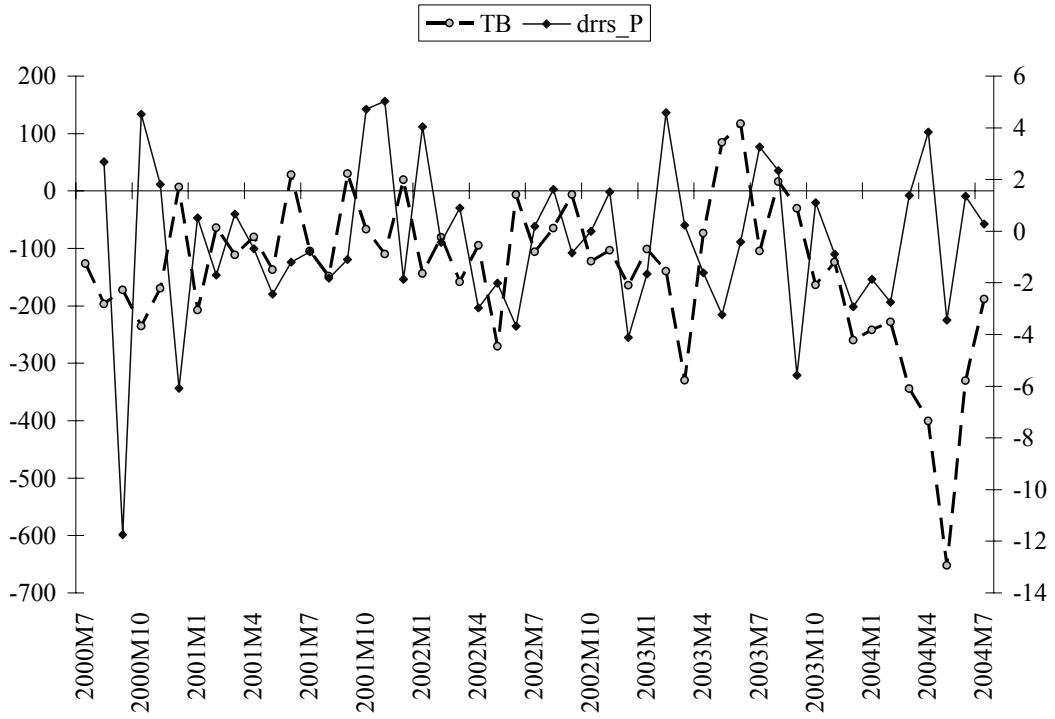


Figure 33
Pak – Euro Trade Balance and Real Devaluation

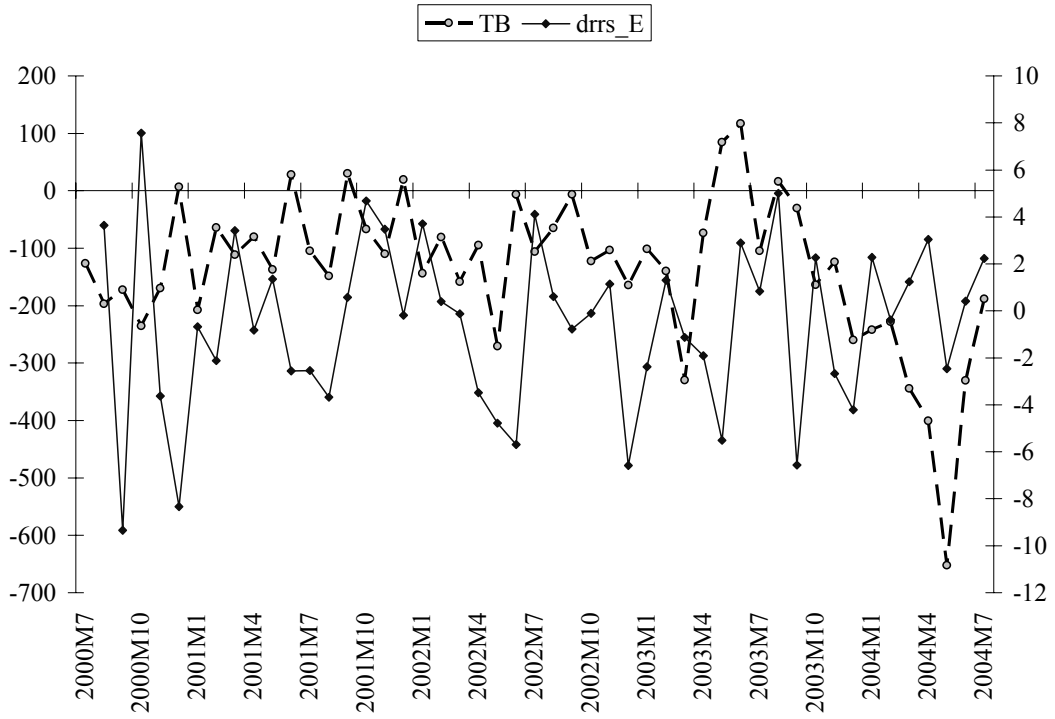


Figure 34
Pak – Japan Trade Balance and Real Devaluation

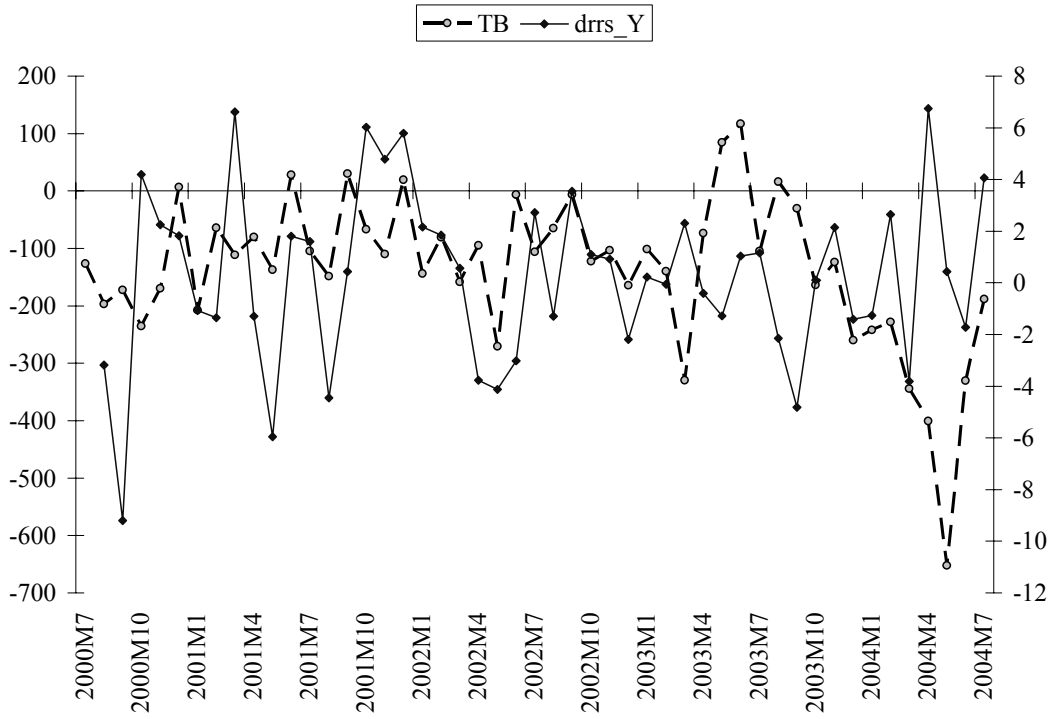


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Figure 35
Pak – US Changes in FOREX reserves and Nominal Devaluation

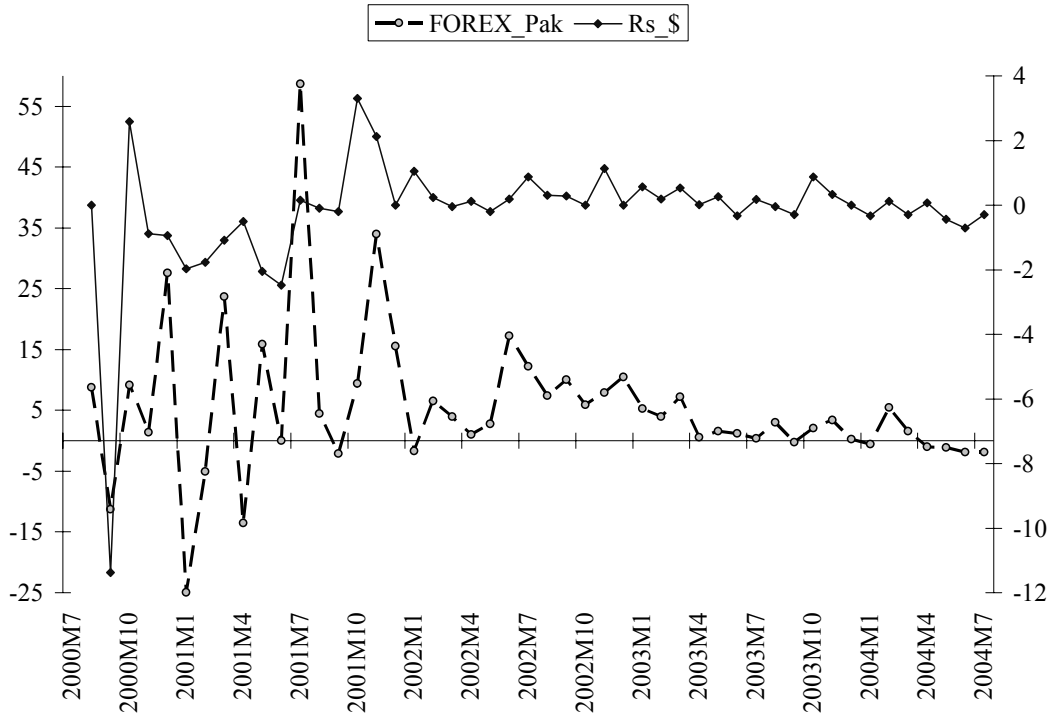


Figure 36
Pak – UK Changes in FOREX reserves and Nominal Devaluation

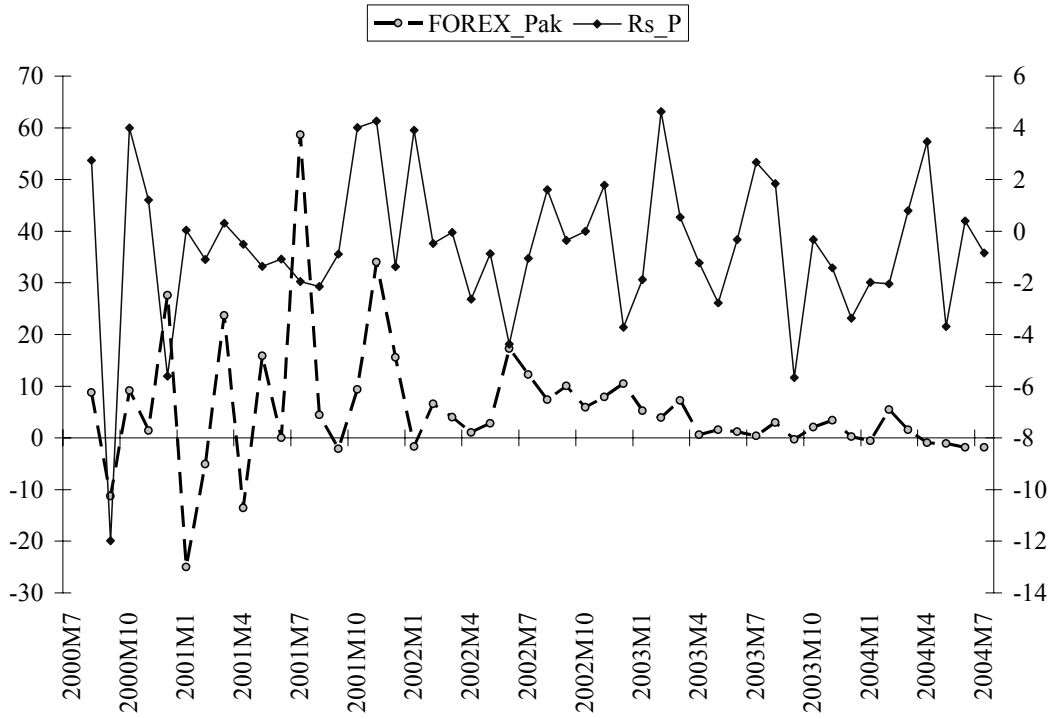


Figure 37
Pak – Euro Changes in FOREX reserves and Nominal Devaluation

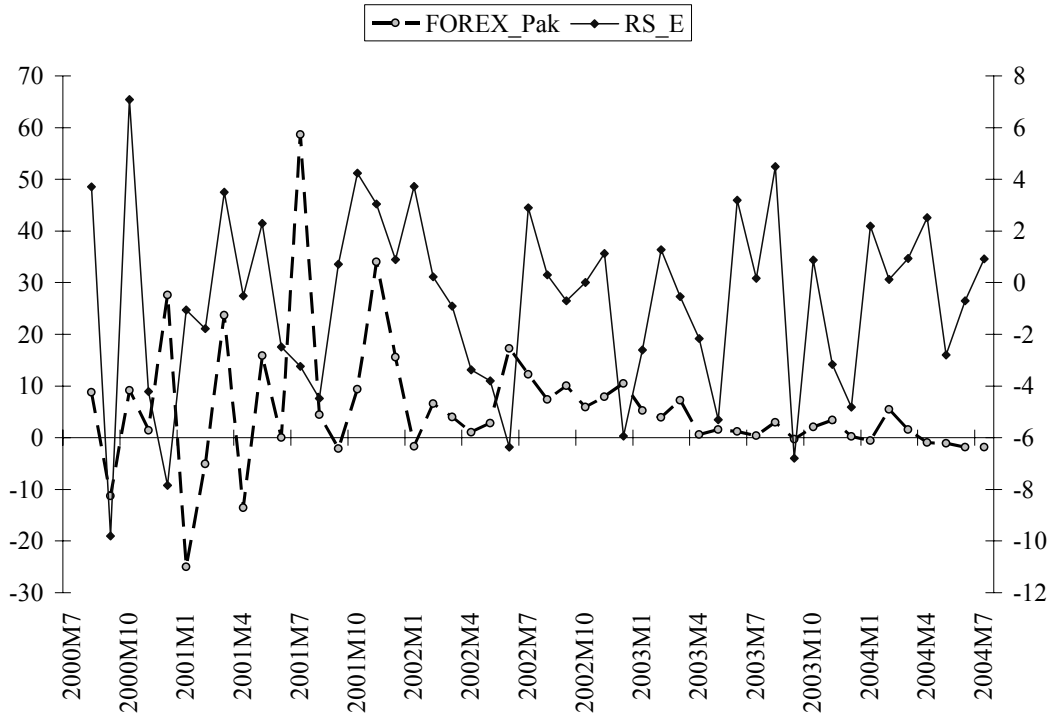
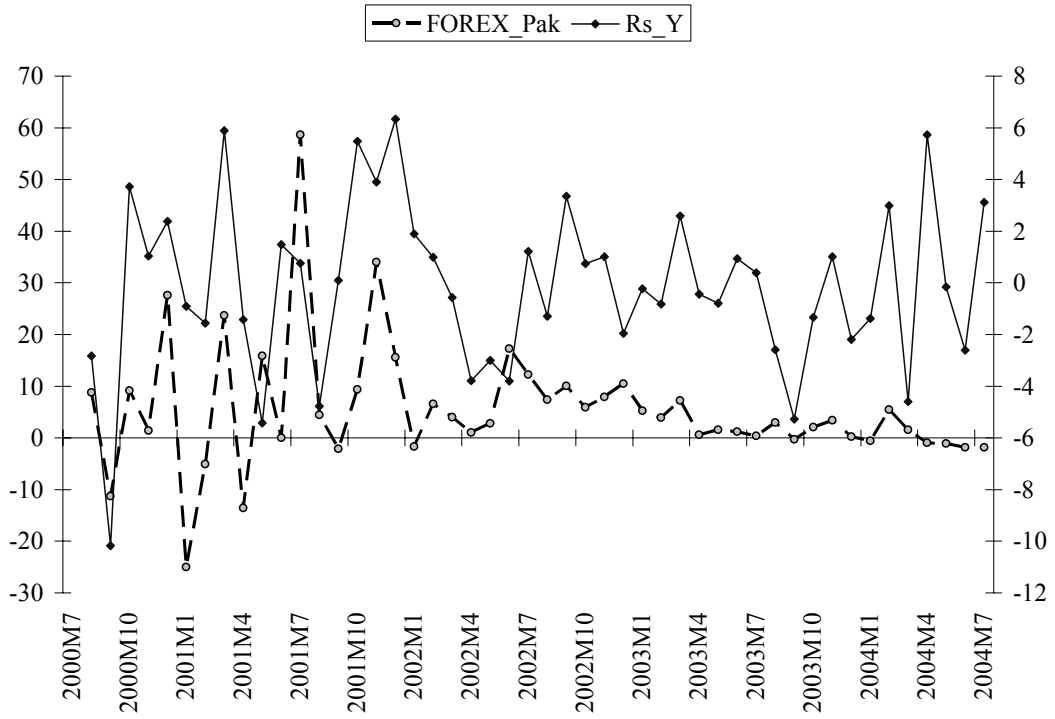
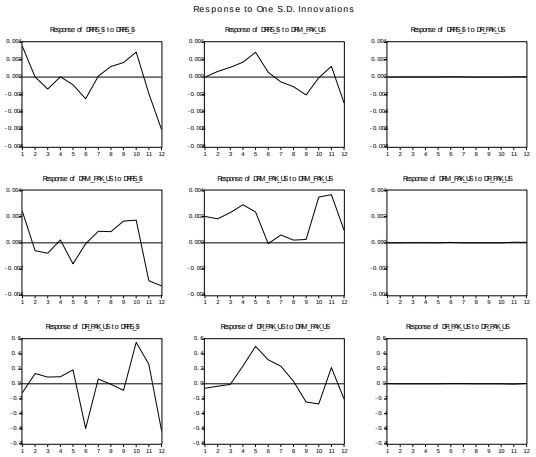


Figure 38
Pak – Japan Changes in FOREX reserves and Nominal Devaluation

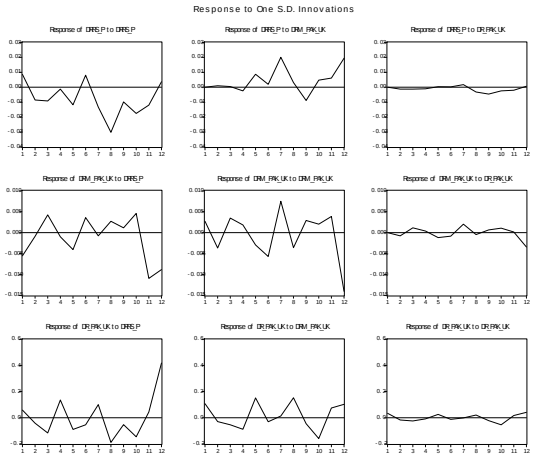


APPENDIX B

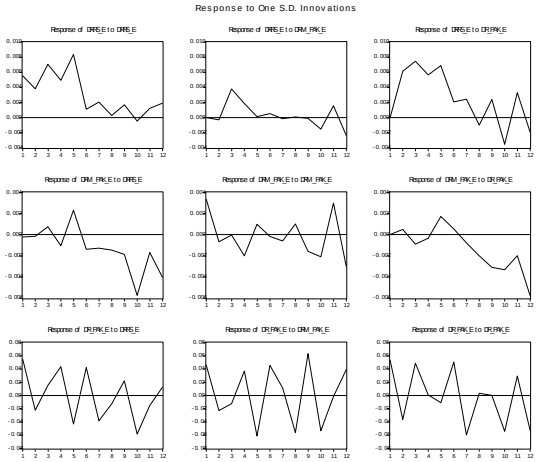
Graph A1
IRF of Pak – US Real Exchange Rate, Real Money Differential, and Real Interest Differential



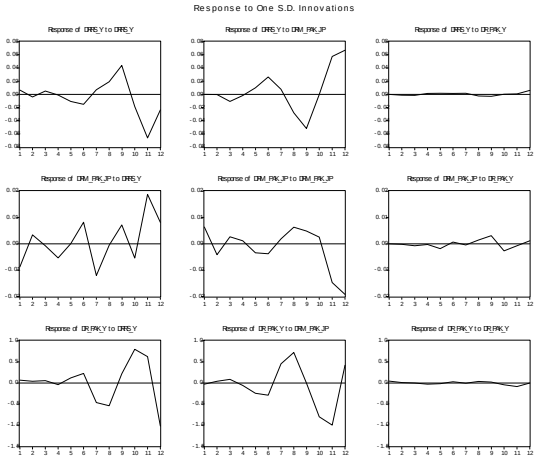
Graph A2
IRF of Pak – UK Real Exchange Rate, Real Money Differential, and Real Interest Differential



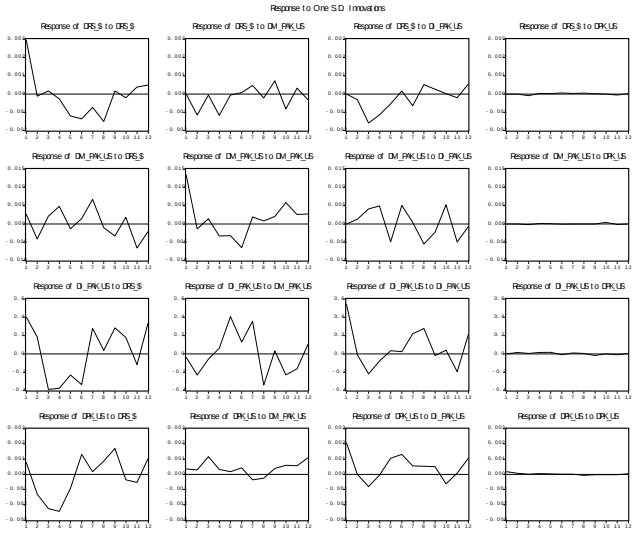
Graph A3
IRF of Pak – Euro Real Exchange Rate, Real Money Differential, and Real Interest Differential



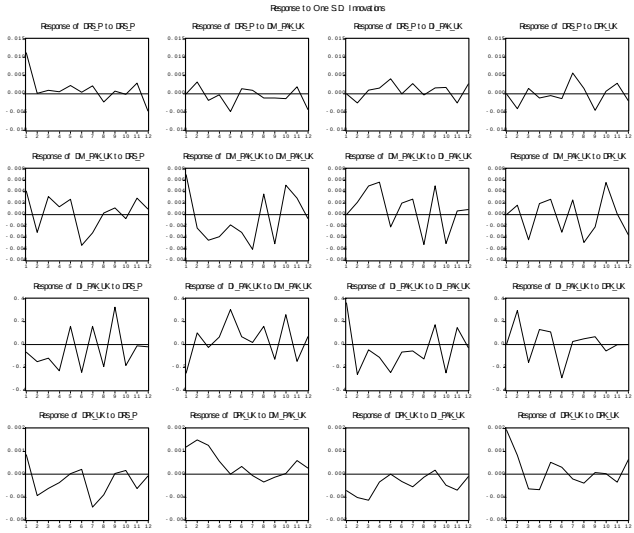
Graph A4
IRF of Pak – Japan Real Exchange Rate, Real Money Differential, and Real Interest Differential



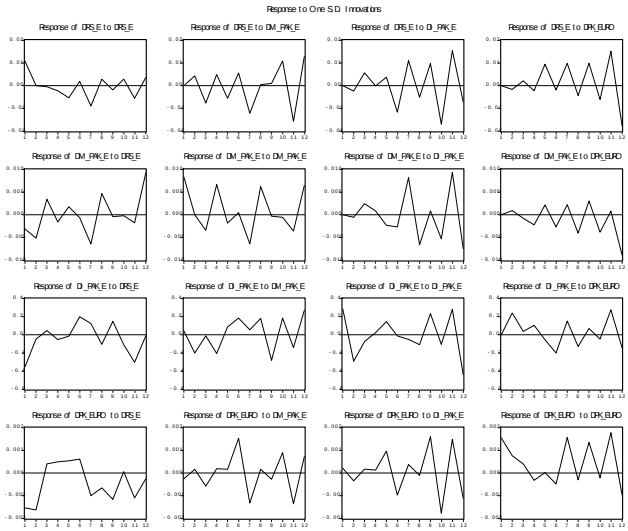
Graph A5
IRF of Pak – US Nominal Exchange Rate, Nominal Money Differential, Nominal Interest Differential and relative prices



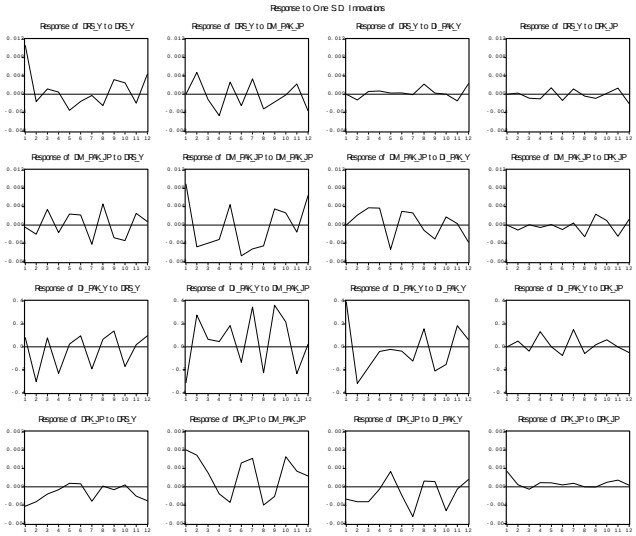
Graph A6
IRF of Pak – UK Nominal Exchange Rate, Nominal Money Differential, Nominal Interest Differential and relative prices



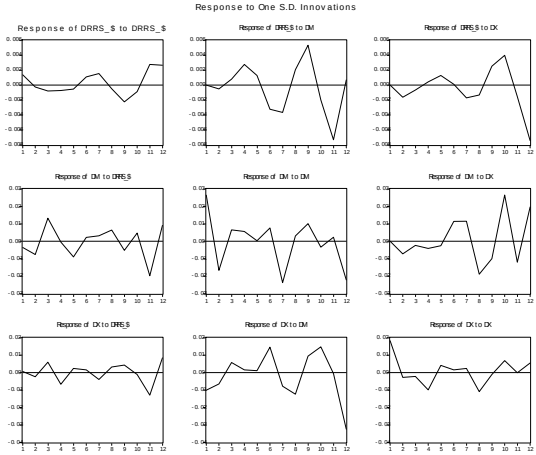
Graph A7
IRF of Pak – Euro Nominal Exchange Rate, Nominal Money Differential, Nominal Interest Differential and relative prices



Graph A8
IRF of Pak – Japan Nominal Exchange Rate, Nominal Money Differential, Nominal Interest Differential and relative prices



Graph A9
IRF of Pak – US Real Exchange Rate, Imports and Exports



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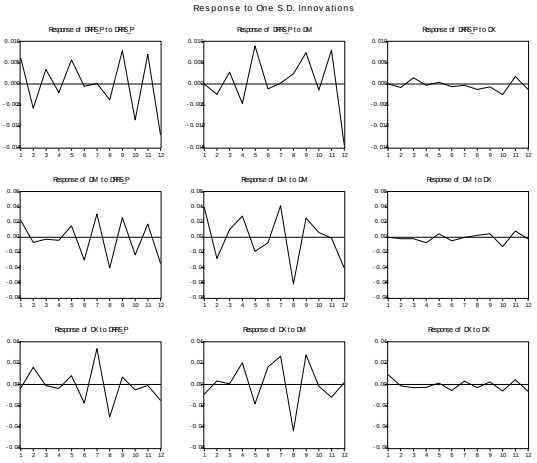
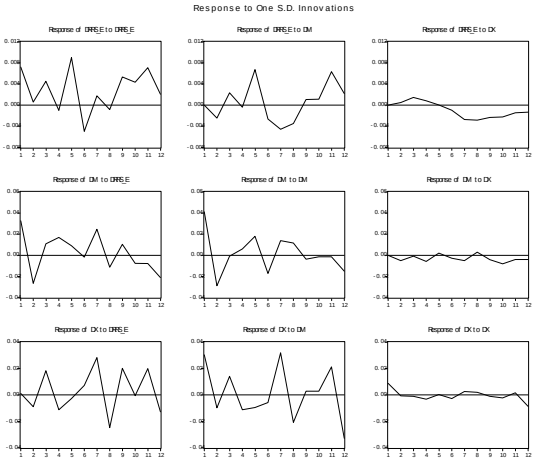
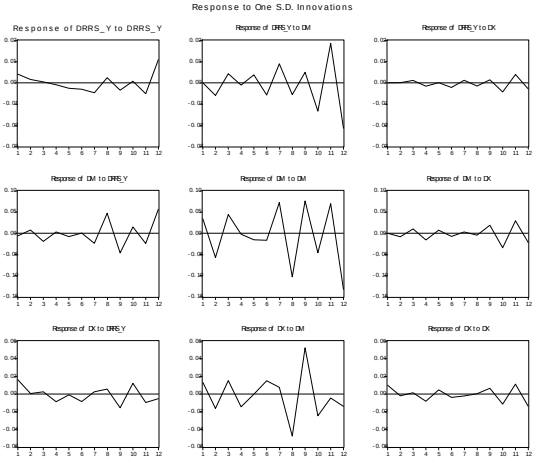
Graph A10
IRF of Pak – UK Real Exchange Rate, Imports and Exports



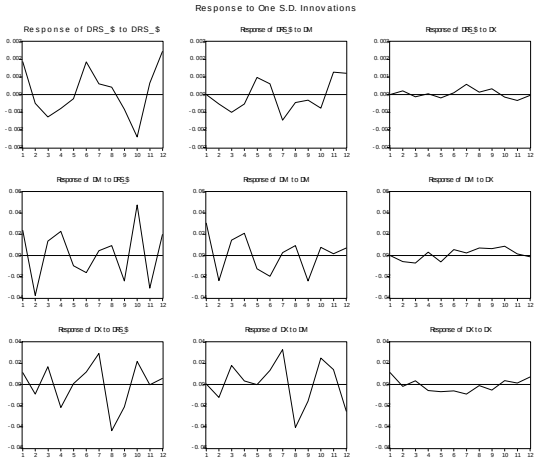
Graph A11
IRF of Pak – Euro Real Exchange Rate, Imports and Exports



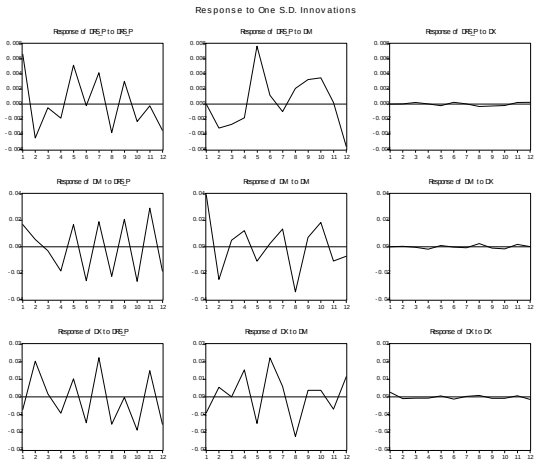
Graph A12
IRF of Pak – Japan Real Exchange Rate, Imports and Exports



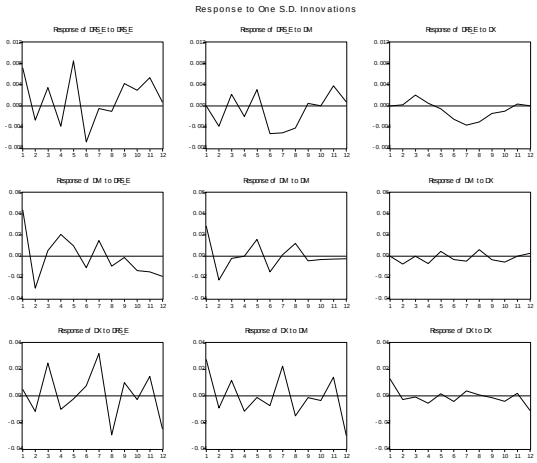
Graph A13
IRF of Pak – US Nominal Exchange Rate, Imports and Exports



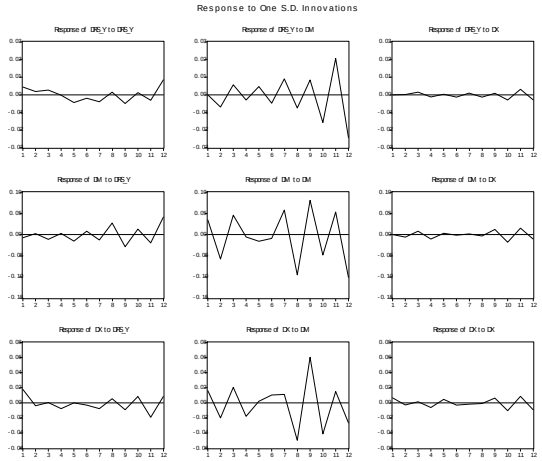
Graph A14
IRF of Pak – UK Nominal Exchange Rate, Imports and Exports



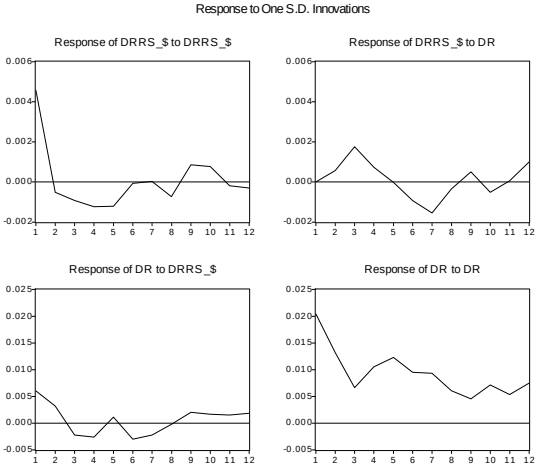
Graph A15
IRF of Pak – Euro Nominal Exchange Rate, Imports and Exports



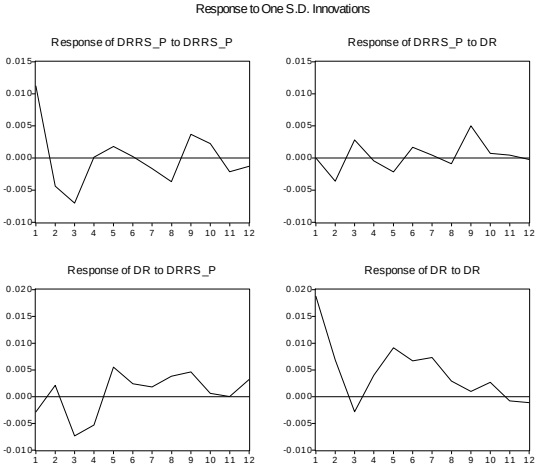
Graph A16
IRF of Pak – Japan Nominal Exchange Rate, Imports and Exports



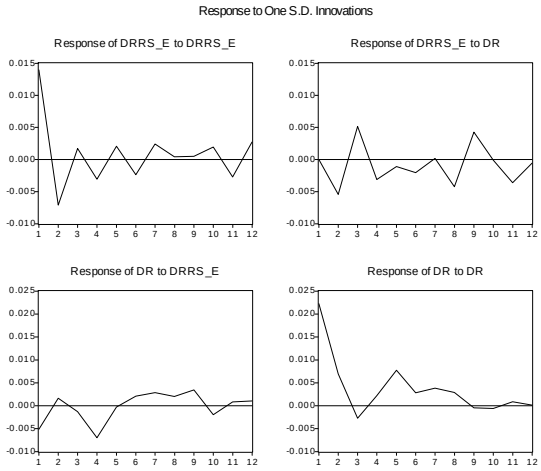
Graph A17
IRF of Pak – US Real Exchange Rate, and FOREX Reserves



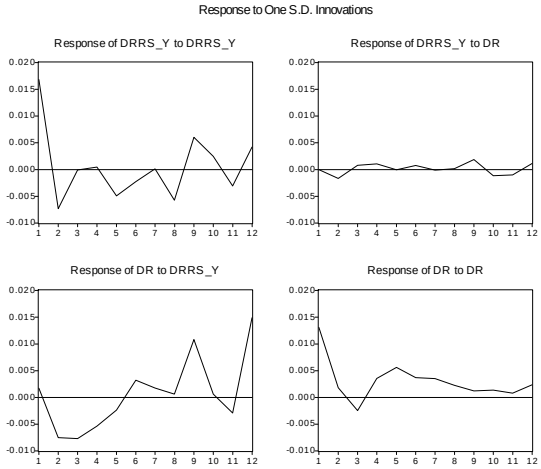
Graph A18
IRF of Pak – UK Real Exchange Rate, and FOREX Reserves



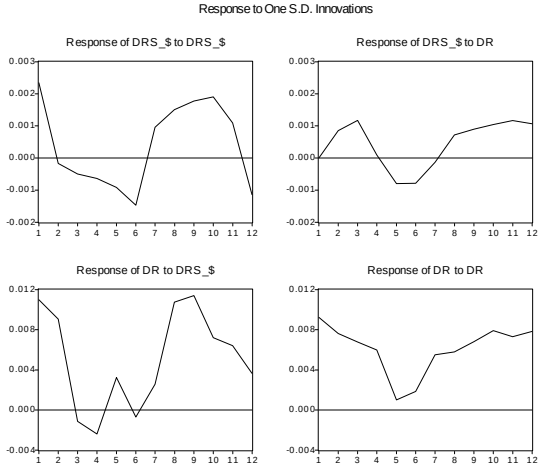
Graph A19
IRF of Pak – UK Real Exchange Rate, and FOREX Reserves



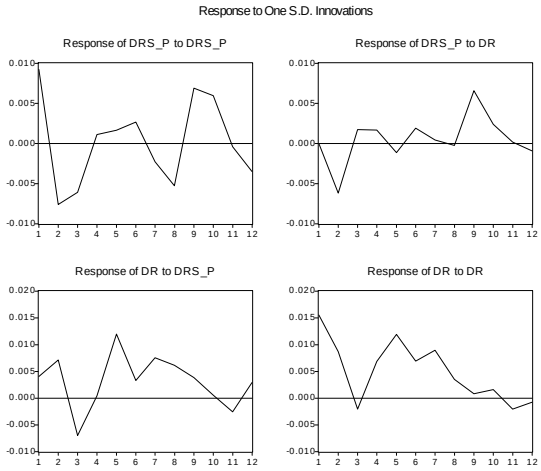
Graph A20
IRF of Pak – UK Real Exchange Rate, and FOREX Reserves



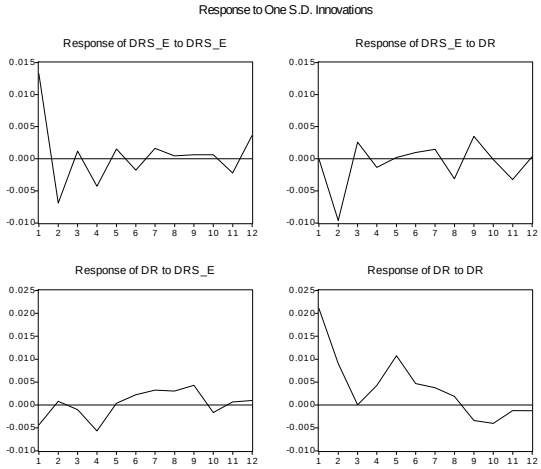
Graph A21
IRF of Pak – UK Nominal Exchange Rate, and FOREX Reserves



Graph A22
IRF of Pak – UK Nominal Exchange Rate, and FOREX Reserves



Graph A23
IRF of Pak – Euro Nominal Exchange Rate, and FOREX Reserves



Graph A24
IRF of Pak – Japan Nominal Exchange Rate, and FOREX Reserves