How External Shocks and Exchange Rate Depreciations Affect Pakistan? Implications for Choice of an Exchange Rate Regime*

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Abstract: A structural vector autoregression (VAR) model shows that external shocks are important in driving economic fluctuations in Pakistan and their importance has increased since September 11, 2001. The primary source of external shocks is foreign remittances, while foreign output has a limited effect. Keeping fixed external factors, an exogenous real exchange rate depreciation shock lowers output—a positive effect on real net exports (largely resulting from import compression rather export expansion)—is more than offset by a decline in domestic demand. The absence of common shocks with major trading partners, the importance of remittances, conventional expansionary effects on the trade balance following a real currency depreciation, and only limited evidence that credibility of anti-inflationary policy would improve with a currency peg support greater exchange rate flexibility. However, the rather large contractionary effects of real exchange rate depreciation on domestic demand suggest that greater exchange rate flexibility could destabilize aggregate output.

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1. Introduction

This paper examines the sources of economic fluctuations in Pakistan using a structural vector autoregression (VAR) methodology. Specifically, we determine the extent to which changes in output, inflation, and the real exchange rate in Pakistan are driven by external shocks—terms of trade, foreign output, and foreign remittances shocks—and the role that real exchange rate shocks play in driving the economy. The primary goal of the analysis is to highlight the implications of the results for choice of exchange rate regime in Pakistan.

It is now generally well-understood that the traditional literature on the choice of exchange rate regimes might be of only limited relevance to developing countries because of the special problems that they face.[1] One such problem is that exchange rate depreciations are often contractionary rather than expansionary in these countries.[2] This means that one key advantage of floating exchange rates—that of providing an appropriate adjustment mechanism to various kinds of shocks—is negated; exchange rate flexibility with "contractionary devaluations" could actually destabilize, rather than stabilize, the economy.

On the other hand, there is also a near-consensus that should these countries decide to peg their currencies, the only viable pegs would be to hard currencies like the dollar, euro, or the yen. And this means that these countries are unlikely to satisfy the criterion of having common shocks with their potential anchor currency countries either.

So, under these special circumstances, what should developing countries do—fix or float? There is no clear-cut answer. There is an argument for fixing, along the following lines:

[1] This traditional literature is embodied in the classic works of Mundell (1961) and McKinnon (1963), and Kenen (1969) on optimal currency areas.

[2] The literature on contractionary devaluations dates back several decades and has continued to expand in recent years. See, for example, Diaz Alejandro (1963), Cooper (1971), Krugman and Taylor (1978), Edwards (1989), Lizondo and Montiel (1989), Agenor (1991), Kamin and Klau (1996), Kamin and Rogers (2000), Ahmed et al (2002), and Ahmed (2003).

these countries do not have common shocks with potential anchor countries, but they do not gain much from exchange rate flexibility either which is destabilizing; so they might as well fix to have a nominal anchor for inflation, which would make anti-inflation policy more credible.[3]

But there is a counterargument: exchange rate depreciations have been contractionary in the historical record of developing countries only because these depreciations have been dominated by forced exits from non-viable pegs in crisis times.[4] Therefore, the contractionary devaluations do not indicate that exchange rate flexibility cannot be stabilizing in these countries but rather that soft (or adjustable) pegs do not work.

Another factor is the importance of external shocks in general, not just with the potential anchor currency country. External shocks have to be of some importance to a country to begin with for exchange rate flexibility to have the potential to mitigate and provide an appropriate adjustment mechanism to any adverse effects of these shocks.

Among the key considerations for any developing country in deciding to fix or to float would, therefore, be the following: the extent to which the country departs from the important traditional criterion of having common shocks with the potential anchor country, how important are external shocks overall, and whether exchange rate depreciations are contractionary or expansionary.

If devaluations are contractionary, the channels through which this is occurring can be relevant too. In the older literature on contractionary devaluations, the channel which was

[3] There is also a related debate in the literature about the bipolar view—free floats and hard fixes being the only sustainable option—versus the view that intermediate regimes are possible and even, in some cases, desirable. For the arguments made on the two sides of this debate, see, for example, Williamson (1996), Frankel (1999), and Fischer (2001).

[4] This argument was one motivation behind Reinhart and Rogoff (2004) introducing a new category of exchange rate regime of "freely falling" for very high inflation, frequent depreciation episodes in their "natural" classification scheme.

emphasized was that key inputs had to be imported. A devaluation could thus worsen the trade balance rather than the traditional case of the trade balance improving. The modern literature emphasizes reasons such as currency mismatches on domestic balance sheets.[5] This can have direct as well as indirect consequences for the effects of exchange rate changes. Following currency depreciation, the domestic currency value of domestic liabilities increases; this has a negative effect on wealth and, therefore, consumption and investment. Thus, even if the trade balance does improve following exchange rate depreciation, this can be more than offset by the fall in domestic absorption through the above channel. Due to currency mismatches and other problems of developing countries there can be indirect effects as well, whereby devaluation leads to loss of investor confidence and lack of access to international capital markets, with adverse consequences again for domestic absorption.[6] The implications of fixing versus floating can be different depending on the reasons why devaluations might be contractionary.

In light of the above discussion, in this paper we specifically focus on the following questions with respect to Pakistan's economy: (1) How important are external shocks (terms of trade shocks, shocks to outputs/incomes of major trading partners, and foreign remittance shocks) in driving economic fluctuations? (2) Are exchange rate depreciations contractionary or expansionary? (3) What are the channels through which exchange rate changes affect the economy and how important is their effect relative to other factors? (4) What are the implications of the results for the choice of exchange rate regimes[7]?

[5] Examples of work highlighting the balance sheet mismatches include Eichengreen and Hausmann (1999) and Cespedes, Chang, and Velasco (2000).

[6] This leads developing countries to have a rational "fear of floating" as argued by Calvo and Reinhart (2002) and Hausmann, Panizza, and Stein (2001), for example.

[7]Most empirical evidence from developing countries on the performance of economies under different exchange rate regimes is of the cross-country variety; see, for example, Husain, Mody, and Rogoff

The remainder of this paper is organized as follows: section 2 provides a selective review of previous findings for Pakistan on the effects of remittances and exchange rate changes on the economy; section 3 lays out our empirical methodology; section 4 presents our empirical findings and provides an interpretation of the results; and section 5 concludes.

2. Review of Previous Results

Our study is related to three main lines of previous inquiry with respect to Pakistan's economy: role of external factors, in particular their relationship with exchange rate movements; effects of changes in exchange rates on real variables and implications for choice of exchange rate regimes; and the relationship between exchange rates and prices. Some selected literature on each is reviewed below:

External factors and exchange rate movements

Khan (1986) considered the impact of terms of trade, real GNP of industrial countries, real interest rates in international capital markets, and capital flows on the real exchange rate over the period 1977 to 1984. He concluded that the effect of these external factors on real exchange rate movements was often contrary to that predicted by the theory. This could be either because the authorities pursued exchange rate policies that offset the effects of external factors or because domestic factors moved the real exchange rate in a direction that countered the effects of the external factors.

Ahmed and Ali (1999) used a simultaneous equation framework to trace the pattern and speed of adjustment of the nominal exchange rate and domestic price level in response to domestic and external shocks using data for the period 1982:II to 1996:IV. They considered shock to money supply and real output as domestic shocks and shock to export prices, import

(2005). Husain (2004) develops a template based on *a large number* of relevant criteria, which can be applied to individual countries. Here we focus in detail on just two key criteria for Pakistan—the importance of external shocks and whether devaluations are contractionary or expansionary.

prices, and foreign exchange reserves as external shocks. They found that shocks to money supply, real output and import prices produce larger variations in inflation than in the exchange rate, while the reverse is true for shocks to export prices and foreign exchange reserves. A 10 percent increase in foreign exchange reserves was found to appreciate the exchange rate by 0.1 percent within a quarter. Comparing the responses of prices and exchange rates to various shocks, they also concluded that, in the short run, the price level response to temporary shocks was not in the direction that would offset the exchange rate response and leave the real exchange rate unchanged, but in the long run it was. Thus, they surmised that purchasing power parity (PPP) did not hold in the short run.

Several researchers have also found remittances from abroad to be an important influence on the Pakistan economy. For example, Nishat and Bilgrami (1991), using a standard Keynesian macro model and applying a three-stage least squares (3SLS) estimation technique over the period 1960 to 1988, computed the remittance output multiplier to be about 2.5—that is, a Rs. 1 million increase in remittances would increase GNP by about Rs. 2.5 million, according to their results. Moreover, Haque and Montiel (1992) show that growth in workers' remittances substantially appreciated the real exchange rate over the period 1982 to 1991. Specifically, workers' remittances and official transfers explained 80 percent of the variation observed in the effective real exchange rate over the period. Important determinants of the remainder of the variance were found to be the government's deficit and the effective nominal exchange rate. Khan's paper mentioned earlier also finds that remittances play a critical role in movements of the balance of payments and the real exchange rate.

Effects of devaluation and choice of exchange rate regime

The traditional literature on whether exchange rate devaluation improves the trade balance has focused on whether the Marshall-Lerner stability condition is satisfied. Evidence on this in the case of Pakistan appears to be mixed. Hassan and Khan (1994), estimated export demand, export supply, import demand, and price equations using a 3SLS technique over the period 1972 to 1991. They found the Marshall-Lerner stability condition to be satisfied thus supporting the argument that devaluation would be successful in improving the trade balance.

By contrast, Khan and Aftab (1995) using a somewhat different sample period (1983:I to 1993:III) and an instrumental variable estimation technique find that on aggregate, the Marshall-Lerner condition is not satisfied, thus questioning whether an exchange rate depreciation could bring about much improvement in the trade balance. They also examined disaggregated export data, again finding little support for the strategy of trying to improve exports by a devaluation of the currency—only one-third of the country's exports could be expected to react positively following exchange rate depreciation, according to their findings. Using data disaggregated by Pakistan's four major trading partners, Akhtar and Malik (2000) concluded that real devaluation was likely to improve Pakistan's trade balance with the United Kingdom and Japan but not with the United States or Germany.

Using a more recent sample period of 1980:I to 2000:IV, Aftab and Aurangzeb find support for the Marshall-Lerner condition holding in the long run only. The error correction model they estimate also supports the existence of a J-curve in the short run, whereby the trade balance first deteriorates in the first two quarters following currency depreciation but then improves. Results in Rehman and Afzal (2003) are also consistent with a J-curve, with a negative effect on the trade balance of about six quarters and only then turning positive.

There does not appear to be much work done in the case of Pakistan on the output effects of exchange rate changes and on the choice and consequences of different types of exchange rate regimes. Khan (1986) appears to find merit in a policy of some flexibility of the exchange, arguing that this enhances the ability of the authorities to adjust to a variety of external shocks which are important for the economy. Ahmed (1992) studied the determinants of the nominal exchange rate since the advent of managed float in 1982. Using an error-correction model with monthly observations over the period January 1983 to June 1987, the study found that in the short run, the monetary authorities react to movements of the US dollar vis-à-vis SDR in setting the rupee exchange rate. In the long run, according to the study, the policy was to offset the relative inflation differential between Pakistan and its major trading partners, so as to target a constant real exchange rate. Nabi (1997) discussed the management of the exchange rate as a principle tool of trade policy. We attempt to shed more light on exchange-rate regime issues in this study using our structural VAR model.

Interaction between exchange rates and prices

Most studies for Pakistan do not seem to find a high pass-through from exchange rate changes to prices even for earlier periods when many studies for other developing countries find strong evidence of pass-through. For example, Haque and Montiel (1992) determined that for the period 1982 to 1991 the correlation between nominal exchange rate changes and real exchange rate changes is very high, with a cumulative depreciation in the nominal effective exchange rate of 170 percent over this period being accompanied by a cumulative depreciation of 110 percent in the real effective exchange rate as well. Thus, depreciations of nominal exchange rates do not seem to bring forth accompanying rises in prices so as to prevent the real exchange rate from changing much. Moreover, the error-correction model estimated by Siddiqui and

Akhtar (1999) did not find reveal much evidence of short-run causality from effective real exchange rates to prices (or vice versa for that matter) for the period 1972 to 1998. They did however find causality running from output to the exchange rate.

Using more recent data from 1982:I to 2001:II, Choudri and Khan reach a similar conclusion. By estimating a pass-through equation for domestic inflation as a function of nominal exchange rate depreciation and foreign inflation (weighted average of trading partners' price changes), they conclude that the devaluations of the rupee over the ample period they studied had not transferred much to domestic inflation. They also examined impulse responses from a three-variable VAR with two endogenous variables (exchange rate changes and inflation) and one exogenous variable (foreign inflation). The responses of consumer price inflation to shocks to the exchange rate were close to zero for up to ten quarters.

One study that appears to be an exception and does suggest some evidence of pass-through is Ahmed and Ali (1999). They found causality running in both directions between exchange rate changes and inflation in the short-run for the period 1982-II to1996-IV, with the effect of devaluation on inflation being smaller than that of inflation on devaluation. They also have found the presence of strong inertia in both the inflation rate and exchange rate. It would be interesting to see if our larger VAR system finds any evidence of pass-through from exchange rate changes to inflation.

3. Empirical Model and Methodology

In order to be able to analyze the causal influence of exchange rate shocks on the economy, it is important to control for external factors that might influence both the real exchange rate and domestic output and inflation. However, to keep the system manageable we can only control for a limited number of these. We believe that potentially the key external

factors that the Pakistan economy could be very sensitive to are terms of trade, output/incomes of its trading partners (foreign output), and remittances from abroad.

The empirical methodology is to estimate a six-variable structural vector autoregression (VAR) using annual data over the period 1977-2005[8]. This structural VAR is basically a dynamic simultaneous equation model. Of the six variables we consider, three (the terms of trade, foreign output, and remittances) are determined only by external factors and labeled "external variables" while the remaining three (real exchange rate, output, and inflation) are influenced by domestic factors *in addition to external factors*, and are labeled "domestic variables."

Structural VAR

Specifically, we estimate the following system of structural equations:

$$AX_t = \sum_{j=1}^{k} B_j X_{t-j} + u_t \equiv B(L) X_{t-j} + u_t \qquad (1)$$

where X refers to the vector of stationary variables in the model, A is the matrix of contemporaneous interactions between the endogenous variables, B_j's are matrices representing lagged effects with $B(L) = \sum_{j=1}^{k} B_j L^j$ being matrix polynomials in the lag operator, and u is a vector of *i.i.d.* structural disturbances with covariance matrix D, which is diagonal. Intercept terms are included in the empirics but have been omitted here for the sake of convenience.

It will be useful to partition X into "external" and "domestic" variables along the lines discussed earlier and also to partition the structural disturbances correspondingly into external and domestic shocks. Thus,

[8] This follows the approach taken by Ahmed (2003) for a panel of Latin American countries.

$$(2) \qquad X \equiv \begin{pmatrix} X_1 \\ X_2 \end{pmatrix} = \begin{pmatrix} \Delta tot \\ \Delta fy \\ \Delta rm \\ \Delta rer \\ \Delta y \\ \Delta p \end{pmatrix}; \qquad u \equiv \begin{pmatrix} \varepsilon \\ \eta \end{pmatrix} = \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \eta_1 \\ \eta_2 \\ \eta_3 \end{pmatrix}$$

where the external stationary variables–represented by X_1–are the rate of change of the terms of trade (Δtot), foreign output growth (Δfy), the growth rate of remittances from abroad (Δrm) and the domestic stationary variables–represented by X_2–are the rate of depreciation the real effective exchange rate (Δrer), domestic output growth (Δy), and domestic inflation (Δp). The vector ε represents the vector of external shocks (the terms of trade, foreign output, and remittance shocks, respectively); and the vector η represents the vector of domestic shocks (a domestic real exchange rate shock, a domestic output shock, and a domestic price level shock, respectively)–i.e. after accounting for the influence of the external shocks on these variables.

It is well-known that the assumptions that the fundamental economic disturbances in the vector u are *i.i.d.* and, therefore, have a diagonal covariance matrix do not fully identify structural models like (1). To meaningfully analyze the effects of various shocks, some further identification restrictions have to be imposed. The identification scheme embedded in our system can be described by restrictions on the A and B matrices, which are shown in the equations below after partitioning these matrices in a manner conformable to the partition of the external and domestic variables:

$$(3) \qquad A \equiv \left(\begin{array}{c|c} A_{11} & A_{12} \\ \hline A_{21} & A_{22} \end{array}\right) = \left(\begin{array}{ccc|ccc} 1 & 0 & 0 & 0 & 0 & 0 \\ * & 1 & 0 & 0 & 0 & 0 \\ * & * & 1 & 0 & 0 & 0 \\ \hline * & * & * & 1 & 0 & 0 \\ * & * & * & * & 1 & 0 \\ * & * & * & * & * & 1 \end{array}\right)$$

$$(4) \qquad B(L) \equiv \left(\begin{array}{c|c} B(L)_{11} & B(L)_{12} \\ \hline B(L)_{21} & B(L)_{22} \end{array}\right) = \left(\begin{array}{ccc|ccc} * & * & 0 & 0 & 0 & 0 \\ * & * & 0 & 0 & 0 & 0 \\ * & * & * & 0 & 0 & 0 \\ \hline * & * & * & * & * & * \\ * & * & * & * & * & * \\ * & * & * & * & * & * \end{array}\right)$$

where an asterisk denotes that the coefficient is unrestricted.

The small open economy assumption would seem to apply to Pakistan with the consequences that external variables can be taken to be causally prior contemporaneously to the domestic variables and that domestic variables do not have feedback effects on the external variables with a lag either; that is, the system is block recursive. These consequences are reflected in A_{12} and $B(L)_{12}$ being null matrices, respectively.

For the external variables it is assumed that, contemporaneously, terms of trade are causally prior to both foreign output and remittances and that foreign output is causally prior to remittances, which results in the A_{11} matrix being lower triangular. It seems fairly plausible that remittances would be affected by conditions prevailing in the countries from which they are being sent but not affect those conditions, which is what the above assumptions imply. For terms of trade being casually prior to foreign output, our intuition is that Pakistan's terms of trade are affected by world prices such as those of oil and cotton and it seems more plausible that such commodity price changes can be regarded as causally prior to foreign output, rather than vice versa. Nevertheless, we have checked robustness with respect to alternative causal orderings of the external variables. Note that the zero elements in $B(L)_{11}$ imply that remittances cannot have any perceptible *feedback* effects on terms of trade and foreign output with a lag either.

Within the domestic variables, the contemporaneous causal ordering is assumed to go from the real exchange rate to domestic output to the domestic price level, which translates into a

lower triangular A_{22}. Since prices are usually sticky and take some time to adjust, putting the price level last in the causal ordering seems appropriate. However, it is more controversial what the direction of contemporaneous causality is between the real exchange rate and output. Certainly, changes in exchange rate policy, which could be one source of domestically driven shocks to the real exchange rate, can affect output. However, shocks to domestic activity such as technological innovation or changes in fiscal policy can also affect both output and the real exchange rate. Since, in practice, the exchange rate is more likely to respond to these shocks faster than output, we put the real exchange rate ahead of output in the *contemporaneous* causal ordering; feedback from output changes to real exchange rate changes with a lag is, of course, allowed.

Reduced-form VAR and Identification

The structural VAR given in (1) cannot be directly estimated but must be retrieved from the reduced form of the system. If the A matrix were known, the reduced form could be obtained by applying A^{-1} to the system, which would yield:

$$X_t = A^{-1}B(L)X_{t-1} + A^{-1}u_t \equiv \Gamma(L)X_{t-1} + v_t \tag{5}$$

Letting E be the expectations operator, the relationship between the covariance matrix of the structural disturbances D and the covariance matrix of the reduced-form residuals Ω can be written as:

$$E(v_t v_t') \equiv \Omega = E[(A^{-1}u_t)(A^{-1}u_t)'] = E(A^{-1}u_t u_t' A^{-1'}) = A^{-1}DA^{-1'} \tag{6}$$

Identifying the structural model from the estimated reduced-form (5) thus involves finding an A matrix such that $\Omega = A^{-1}D\,A^{-1'}$ where D is diagonal. This process does not, in general, yield a unique A, which is another way of saying that a simultaneous equation system cannot be retrieved from its reduced form without additional restrictions (e.g. exclusion

restrictions). Our postulated exclusion restrictions discussed earlier imply a lower triangular A, which is enough to make A unique. The magnitude of the elements along the diagonal of D just amount to choosing the units in which the variables are measured. The identification procedure thus involves first finding the unique A such that $\Omega = A^{-1}A^{-1'}$, i.e. setting D to the identity matrix and then renormalizing to make the diagonal elements of A unity, which appropriately sets the units of the variables.

Once the structural VAR has been retrieved, we will examine the relative importance of each external shock and of the external shocks as a group by looking at the variance decompositions. The impulse responses to each of the external shocks will also reveal how, and over what horizon these shocks affect the economy. These exercises will provide the answer to the first question posed earlier regarding the importance of the external shocks.

We will then consider the impulse responses of the identified real exchange rate shock. The effect on domestic output will answer the second question raised earlier of whether exchange rate depreciations are expansionary or contractionary. The impulse responses of domestic prices will shed light on the extent of pass-through.

In order to answer the third question about the channels of transmission of real exchange rate changes, we need to examine separately the effects on domestic absorption, exports, and imports. With annual data, one runs out of degrees of freedom in the case of Pakistan very quickly, so it is not possible to add these variables to the existing VAR. The strategy we follow is to replace output in our VAR with each of the above-mentioned variables in turn and re-estimate the model.

The above results will be interpreted in terms of their implications for choice of an appropriate exchange rate regime for Pakistan. This was the subject of the last question we raised earlier in motivating the paper.

4. Results

In this section, we first discuss the data and do some preliminary analysis of them. Then we discuss the properties of the reduced-form and structural economic disturbances and present the impulse responses, variance decompositions, and historical decompositions from our empirical model and interpret them. This is followed by evidence on the transmission mechanism, and finally the implications for choice of exchange rate regime in Pakistan are discussed.

Preliminary data analysis

The terms of trade are the ratio of unit value of exports to the unit value of imports. Foreign output is computed as an export-weighted average of the real GDP of Pakistan's 10 major export markets. Foreign remittances are total remittances coming into Pakistan from abroad from all countries measured in U.S. dollars. The real effective exchange rate is a trade-weighted, CPI-based real exchange rate expressed as units of domestic goods that have to be given up to get one unit of the foreign good. Thus, a rise in the real exchange rate implies a real depreciation of the Pakistani rupee. Domestic output is real GDP measured at market prices and the price level is taken to be the consumer price index. Real Exports and imports are taken from the national income accounts and thus represent exports and imports of final goods. Finally, domestic absorption is defined as real GDP less net exports, and thus represents the sum of real private and government consumption and investment. The sources of the data are *Economic Survey*, Government of Pakistan and *International Financial Statistics*, IMF (various issues).

Figure 1 gives plots of all of the variables used in this study (in growth rates) with table 1 providing summary statistics. Consider first Pakistan's real GDP growth and its expenditure-side components. Economic growth in Pakistan has been quite volatile with perhaps two distinct sub periods standing out—prior to 1992 when average growth was relatively high (with a mean of 6 percent per annum) and the post-1992 period when the growth was somewhat lower on average (mean of 4 percent) and the volatility of this growth also appears to have been greater. However, more recently, real GDP growth has turned around, with a sharp increase in its pace since 2001. Over the full sample period economic growth averaged about 5 percent with a standard deviation of two percentage points (table 1).

Interestingly, the pattern of growth of domestic absorption looks fairly different from that of GDP growth, suggesting that real export and real import growth have influenced real GDP substantially over the sample period. From 1976 to 1991, export growth seems to show an upward trend, but then it declined sharply, turning negative in the late 1990s. Since 2000, growth of exports has turned positive again, with some years of a fairly high rate of growth. The mean rate of growth of real imports over the sample period has been about a percentage point less than that of exports. There have been three years of notable surges in imports (1979, 1992, and 2005) with the latest surge in 2005 being unusual by historical standards. Barring these three years, the dispersion of import growth has been much less compared to that of export growth.

Pakistan's consumer price inflation has shown several episodes of declining and increasing trends with the mean rate of CPI inflation being about 9 percent with a standard deviation of nearly 6 percentage points over the full sample period. Inflation declined sharply from about 30 percent in 1974 to under 4 percent by 1987 before rising again to 12 percent in

1997. Subsequently, there was another trend decline in inflation to just a little over 3 percent in 2003, before prices accelerated sharply again over the past two years.

There have been lot of oscillations in the rate of change of the real exchange rate—the average rate of depreciation has been about ½ percent over the sample period with a standard deviation of roughly 6 percentage points. Smoothing through the oscillations, there was an increasing trend in the growth rate of the real exchange rate from about 1975 to 1990 (reflecting first a fall in the rate of appreciation and then an increasing tendency toward depreciation). Note also the negative growth rate over the last three years implying substantial recent real appreciation of the rupee.

Turning to external variables, the terms of trade have not been very favorable for Pakistan over the whole sample period as reflected in the mean growth rate of -1 percent. The volatility of the growth of terms of trade has also been very high with a standard deviation of about 12 percentage points. Smoothing through the year-to-year fluctuations, two periods can be identified—from 1974 to 1985 when on average the terms of trade rose by a little over 3 percent per annum and since 1985 when they fell on average by about 3½ percent.

Growth of remittances displays the highest volatility among all our series, but this is largely due to periods of very high growth in the beginning of the sample (late 1970s) and the end of the sample (since 2001) compared with the rest of the sample period. The two prominent growth periods for remittances are likely due to the surge caused by a large number of unskilled workers migrating to the Middle East for the 1970s and due to the events of September 11, 2001 for the most recent period.

Foreign output growth appears to be the only variable that displays a clear decline in volatility over the sample period, with the standard deviation of this variable being much lower

in the period since the mid-1980s. This, by itself, should contribute toward a decline in the volatility of real exports, so the continued volatility of exports must owe to other factors.

Before estimating the VAR we also conducted unit root tests using the Augmented Dickey Fuller (ADF) test to check the stationarity of our time series. In doing this test, optimal lag length was chosen for the dynamics using statistical criteria. Table 2 presents the results of the unit root tests. When applied to the log-level of the series the null hypothesis of unit root was considered against the alternative hypothesis of deterministic trend and when applied to growth rates the null of unit root was considered against the alternative of mean-stationary.

The results reveal that all the variables are non-stationary in their log-level, while the null hypothesis of unit roots (non-stationarity) can be rejected when the variables are considered in their growth rates, with the exception of Pakistan's real GDP growth. This suggests that if we had to choose between a VAR with all variables in log deviations from trend and a VAR in growth rates, the latter would be the appropriate choice, and thus we have estimated our VAR with the variables in growth rate form. Unit root tests can, of course, have low power as has been well established, but these test results are at least not inconsistent with our strong prior of a unit root in log-levels.

Economic disturbances

As discussed earlier, we first estimate a block recursive six-variable reduced-form VAR for Pakistan—the system in (5) above—consisting of the growth rates of the following variables: terms of trade, foreign output, foreign remittances, real effective exchange rate, domestic output, and domestic consumer prices. The estimation uses annual data and sample period is from fiscal years 1976-77 to 2004-05. Based on statistical criteria, an initial lag length of 3 is selected for the VAR. However, with six variables and 3 lags, one does not have many degrees of freedom

left for the domestic variables, the equations for which contain all six variables. Therefore, we have used statistical criteria to further restrict the reduced-form system by first testing and placing zero restrictions when coefficients were not found to be statistically significantly different from zero.

The correlations of the residuals from this restricted reduced-form are shown in table 3. These correlations are useful in that they can tell us how sensitive our results from the retrieval of the structural model (discussed later) are likely to be to alternative contemporaneous causal orderings of the variables (i.e. alternative identification assumptions). Note that the residuals of the equations representing the external variables have very little pair-wise correlation with each other, which suggests that it does not matter much which way we order the external variables among themselves. The correlation between shocks to the real exchange rate and domestic output is significant however, although not very high, at about 0.3, which suggests that the results could be somewhat sensitive to the relative ordering of the real exchange rate and domestic output variables, on which economic theory does not provide a clear-cut choice.

The correlation between the real exchange rate and foreign remittances residuals and between foreign output and domestic output residuals is also significant, but there, given the small open economy assumption, we feel confident assuming *a priori* that remittances are causally prior to the real exchange rate and foreign output is causally prior to domestic output.

After estimating the restricted reduced-form, the structural model given in (1) is retrieved from it using the identification restrictions embedded in (3) according to the procedure detailed in section 3. This yields the fundamental structural disturbances of interest that are orthogonal to each other by construction. These fundamental innovations are plotted in figure 2 and their standard deviations over the sample period are also reported. Note that the volatility of the

fundamental output and price shocks, and to some extent of the real exchange rate shocks, appears to have increased since about 1990. This suggests that domestic shocks impinging on the economy have, on average, been bigger in size in the second part of the sample period.

As far as external shocks are concerned, both terms of trade and remittances shocks are quite volatile. Moreover, remittances shocks appear to have increased in volatility since the events of September 11, 2001 while the volatility of foreign output shocks has decreased since about the mid-1980s.

Impulse responses

Once the structural model has been retrieved, impulse responses are computed and plotted. The impulse responses are the dynamic responses of the variables to shocks to the structural disturbances. They can be obtained by inverting the structural VAR given in (1) to obtain its moving-average representation.[9]

The impulse responses to a one-standard deviation terms of trade shock (which represents roughly a 10 percentage points in its growth rate) are shown in figure 3. The dashed lines represent 1.67 standard-error bands around the responses, which roughly correspond to 90 percent confidence intervals.[10] Both responses of the growth rates as well as log-levels of all the variables are shown. The log-level responses are obtained by cumulating the impulse responses of the growth rates; these can be interpreted as the percent deviation of the levels of the variables from baseline, plotted over the number of years that have elapsed since the shock occurred. Note that since the log-levels are non-stationary variables, their standard-error bands will naturally widen over the horizon. The results on the terms of trade shock are striking in that this shock

[9] Standard econometric packages do this. In our case, the RATS package was used.
[10] Standard errors for the impulse responses and variance decompositions (shown later) were computed using Monte Carlo simulations with 5000 replications.

does not appear to have any statistically significant effect on the real exchange rate, output, and consumer prices in Pakistan (figure 3).

Figure 4 plots the impulse responses of a shock to a weighted average of the outputs of our major export markets. In this case, a one standard-deviation shock amounts to a rise of about 3½ percentage points in the foreign growth rate. The only significant response is that of the real exchange rate which depreciates, on balance, as can be seen from the level-response. After three years, there is about a cumulative 3½ percent depreciation of the real exchange rate relative to the baseline. This result is consistent with the Balassa-Samuelson effect if we take the rise in foreign output relative to domestic output to reflect, partly at least, an increase in foreign productivity relative to domestic productivity. Also, intuitively, as foreign economies' growth increases, more remittances tend to come in from them (about a 20 percent increase in remittances relative to baseline after 3 years); although large, this response has a high standard error and is not statistically significant. Interestingly, there is no clear and significant spillover effect to domestic output from the shock to foreign output.

In contrast to the other external shocks, an exogenous shock to foreign remittances has rather large effects on Pakistan's economy. As shown in figure 5, a one standard-deviation shock of about 30 percentage points to the growth rate of remittances causes domestic output growth to rise by ¾ percentage points each year, two and three years later. After three years, there is a cumulative increase in output of about 1½ percent. This shock also causes a substantial real appreciation of the Pakistani rupee, a cumulative appreciation of about 5 percent after four years. The strong inflow of remittances does not appear to raise domestic inflation, though.

Finally, figure 6 depicts the impulse responses to an exogenous real exchange rate depreciation shock. We reiterate that in identifying the real exchange rate shock the effects of

external shocks on the real exchange rate and domestic output, etc, have been kept fixed separately, so this exogenous real exchange rate depreciation shock can be thought of as a domestically-induced (e.g. policy-driven) shock. A one standard-deviation shock in this case is roughly a 3 percentage point increase in the rate of depreciation of the real exchange rate. Note that after a statistically insignificant increase in output growth on impact, after a year output growth falls by about ½ a percentage point and this effect is statistically significant. The level of output goes below baseline after a year and stays below for two years. Thus real exchange rate depreciations tend to be somewhat contractionary rather than expansionary in the case of Pakistan, consistent with the experience of many other developing countries.[11] There is also some pass-through effect to prices with the inflation rate rising in response to the real exchange rate depreciation and with a positive effect (a cumulative effect of nearly 2 percent) on the level of prices as well.

Variance decompositions

How much do the external and domestic shocks contribute both as a group and individually to economic fluctuations in Pakistan? This depends not just on the size of the impulse responses when a shock of a given size occurs—which have been presented above—but also how often and, on average, what size shocks hit the economy. This question can be answered by considering the variance decompositions, which measure the percentage of the forecast error variances of a particular variable at various forecast horizons that are attributable to each of the individual shocks or a group of shocks. These are presented in tables 4-6, along with their computer-simulated standard errors in parentheses.

[11] See Ahmed *et al* (2002) and Ahmed (2003) for some evidence for other developing countries and a comparison of industrial countries with developing countries in this respect.

As shown in table 4, at a one-year forecast horizon, only about 20 percent of the forecast error variance of the change in the real exchange rate can be accounted for by external shocks, while this ratio rises to 60 percent for a 3-year horizon. Thus, both external and domestic shocks appear to explain the variance of real exchange rate changes around the baseline forecast. This is plausible, since we would expect the real exchange rate to be influenced heavily by both domestic factors as well as developments in the economies of a country's major trading partners.

Table 5 shows the variance decomposition of domestic output growth. At a 1-2 year forecast horizon, the bulk of the forecast error variance (about 75 percent to 80 percent) is explained by domestic shocks. However, external shocks become very important at the 3-year horizon, accounting for roughly about half of the forecast error-variance; remittance shocks alone explain about 20 percent of the error variance. Thus external shocks, particularly remittance shocks, appear to be a very important source of fluctuations in domestic output growth around the baseline. Real exchange rate shocks are also an important determinant of output fluctuations; the contribution of real exchange rate shocks to the forecast error variance of output growth peaks at 23 percent for a 2-year forecast horizon and is in the neighborhood of 10 percent at other forecast horizons.

External shocks are also important in the variance decompositions of inflation at a greater than 1-year horizon, as shown in Table 6, although not as important as for output. 35 percent of the error variance of the inflation rate at a 3-year horizon can be explained by external shocks, with all three external shocks contributing to this. Real exchange rate shocks explain only up to about 10 percent (at a 3-year horizon) of the forecast error variance of inflation

Historical decompositions: Evidence on the importance of post-Sep 11, 2005 shocks

Casual empiricism suggests that the importance of external shocks as an influence on the Pakistani economy has increased substantially following the events of September 11, 2005. We can examine this issue more formally by looking at the historical decompositions. Unlike the variance decompositions, which provide a breakdown of the *unconditional* forecast error variances, the historical decompositions give us the breakdown of the contribution of shocks over a specific period. More specifically, an initial period is chosen and baseline forecasts are made based on information and data available up to that period. The contributions of the different shocks to the deviation of actual values from the baseline path thus computed constitute the historical decompositions.

Using data up to 2000-01 (the fiscal year immediately prior to the one in which September 11, 2001 falls) to make the baseline forecasts, historical decompositions for the growth rates of the real exchange rate, domestic output growth, and domestic inflation for the fiscal years 2001-02 (labeled 2002) through 2004-05 (labeled 2005) are shown in figures 7-9, respectively. Note that, for all three variables, the actual growth rates deviate quite a bit from the baseline forecasts (see the first panels of the three figures), in general. Thus all the shocks taken together have been important for driving fluctuation in these variables.

The comparison of actual growth rate of the real exchange rate with the growth rate that would have prevailed if only external shocks had impinged on the economy is shown in the second panel of figure 7. External shocks as a group make the exchange rate deviate substantially from the baseline forecast and a good part of it appears to be because of shocks to remittances in the post-2001 period.

The results on the historical decompositions of domestic output growth shown in figure 8 are particularly striking. Again, the baseline deviates substantially from the actual growth of output; for example, in 2005 the actual growth rate of real GDP at market prices was 7.8 percent, whereas the baseline forecast in the absence of any shocks after 2001 would have been 3.4 percent. Once we add the influence of the three external shocks, we get quite a bit closer to the actual growth rate; for example, in 2005, growth would have been 6.2 percent if only the external shocks had hit the economy, compared with actual growth of 7.8 percent.

The third panel also indicates that clearly the main external influence since 2001 has been shocks to remittances rather than terms of trade or foreign output growth shocks; with remittance shocks alone, the growth rate would have been 6.3 percent, even slightly closer to actual growth than with all the external shocks together. Interestingly, a comparison of the baseline forecast with the baseline forecast plus the influence of remittance shocks added reveals that economic growth would have been more than 2½ percentage points less in each of fiscal years 2004 and 2005 had the remittances shocks since 2001 not impinged on the economy.[12]

The historical decompositions for consumer price inflation shown in Figure 9 reveal that the inflation rate with external shocks only would have been higher than actual inflation in the fiscal years 2002, 2003, and 2004. However, this was probably related to domestic policy, in the sense that the increase in international reserves resulting from the external shocks was only partly sterilized as part of an expansionary monetary policy.

Channels of transmission

Here we attempt to address what are the channels through which the contractionary effects of a devaluation occurs. Is it that the trade balance deteriorates following a real

[12] The big remittance shock was in 2002 (see figure 2), but recall that the effects of this shock on output were shown in the impulse responses to occur with a lag.

depreciation instead of improving, or is it that the special problems of developing countries discussed earlier also are particularly relevant for Pakistan and lead currency depreciations to have a negative effect on domestic demand? The natural way to address these questions would be to augment our VAR system to include trade variables and domestic absorption. But in the case of Pakistan this is not feasible because the data are annual data available only since about 1975 or so; therefore, a larger VAR system will quickly run into a degrees of freedom problem. Instead, therefore, we have chosen to examine this issue by replacing the output variable in our VAR system by, in turn, domestic absorption (the sum of private and government investment and consumption), real exports, and real imports.

The impulse responses to a real exchange rate shock from each of these three alternative models are presented in figures 10-12. As can be seen from figure 10, the contractionary effects of a real depreciation of the currency come through much more clearly in the absorption model rather than the benchmark output model presented earlier. Specifically, a one standard-deviation shock to the rate of change real exchange rate (which is still about a 3 percentage point shock) lowers domestic absorption growth by about 0.2 percentage points on impact and about ¾ of a percentage point a year later and the shock continues to have a negative effect on absorption growth subsequently as well. Cumulating the growth effects, there is a negative effect on the level of absorption after four years of over 2 percent, and this is statistically significant.

These results suggest that contractionary effects of devaluation on domestic absorption are partially offset by a conventional improvement in net exports, leading to a much smaller contractionary effect on output itself. This raises the question of whether the improvement in net exports occurs through exports or imports, which can be discerned from the estimation of the model with exports and the model with imports. As depicted in figure 11, export growth does

expand by about 2 percentage points after a year in response to about the same-size real exchange rate depreciation shock as above, but the initial growth response of exports is negative and subsequently it turns negative too, so there is only a very modest net positive effect on the level of exports over time (of about 1 percent), which is not statistically significant.

As shown figure 12, there is a negative effect on imports, which is quite a bit bigger in magnitude than the export effect—after two years the level of imports is down by a little more than 3 percent (statistically significant). Thus the conventional response of an improvement in the trade balance following real depreciation of the currency appears to be occurring, but it is much more through a compression of imports rather than an expansion of exports.

Implications for exchange rate regime

The dynamic response of Pakistan's output to shocks to the outputs of its major trading partners is not very large and such shocks are not of major importance to Pakistan's economic growth or inflation. This implies that there is not a good case for Pakistan fixing its currency to the dollar or to another hard currency of one of its other major trading partners on the basis of the traditional fixed exchange rate argument of common shocks with its trading partners.

The results also suggest that there might only be limited scope in the case of Pakistan to improve the credibility of anti-inflationary policies through fixing the exchange rate. Although there is a fairly large pass-through effect to prices from exchange rate depreciation shocks to prices, such shocks do not explain much of the forecast error variance of inflation. Also, the credibility gains from fixing an exchange rate are biggest when the currency peg leads to a country gives up its independent monetary policy. As we know from the impossible trinity, fixing the exchange rate (even if it is a rigid fix) leads to independent monetary policy only with perfect capital mobility, which is not the case in Pakistan.

Furthermore, external shocks in general do form a very important influence on Pakistan's economy even if they are not in large part common shocks with important trading partners of the type that might lead to common business cycles. In particular shocks to remittances are major determinants of the forecast error variance of Pakistan's real GDP growth. There is also clear evidence that the importance of such shocks for Pakistan has increased since in the post-September 11, 2005 world. This suggests that some exchange rate flexibility might be a useful tool for Pakistan to deal with such shocks, allowing the exchange rate to appreciate some in response to positive shocks to remittances (which has happened to some degree in recent years) and letting it depreciate some in response to negative shocks.

Our empirical results also suggest that exchange rate flexibility can act as a stabilizing influence on the trade balance. We find a conventional improvement in net exports following real exchange rate depreciation. However, it is important to reiterate that this improvement occurs in large part because imports fall and only in small part because exports improve.

Thus far, there appears to be a case for allowing a substantial degree of flexibility in the exchange rate. But one of our main results is that Pakistan suffers very much from the typical developing country syndrome of real exchange rate depreciations having a contractionary effect on domestic demand. The negative effect on domestic absorption appears to be large enough to more than offset the positive effect coming from an improvement in net exports, so that, on net, exchange rate flexibility may not help in stabilizing overall output, even as it stabilizes the trade balance.

The negative effect on domestic demand from currency depreciation probably is a refection of the special problems that Pakistan has historically shared with many developing countries—currency mismatches on domestic balance sheets resulting from an inability to

borrow long term in domestic currency, "fickle and moody" international capital flows that are subject to sudden starts and stops, and lack of credibility and stability of domestic policies. The history of these problems, and the resulting implications, makes the case for substantial flexibility of exchange rates mixed. However, recent improvements, particularly in the stability and credibility of macroeconomic policies, should bolster the case for a more flexible exchange rate regime.

5. Summary and Conclusions

In this study, we posed the following questions for Pakistan's economy: How important are external shocks (terms of trade shocks, shocks to outputs/incomes of major trading partners, and foreign remittance shocks) in driving economic fluctuations? (2) Are exchange rate depreciations contractionary or expansionary? (3) What are the channels through which exchange rate changes affect the economy and how important is their effect relative to other factors? (4) What are the implications of the results for the choice of exchange rate regime? We estimated a structural VAR using annual data over the period 1977 to 2005 and considered impulse responses, variance decompositions, and historical decompositions to address the above questions. Our empirical analysis suggests the following answers:

First, terms of trade shocks appear to have very little effect on Pakistan's real exchange rate, domestic output, and domestic prices. However, because the volatility of these shocks is relatively high, they do explain a non-trivial proportion of the fluctuations of these variables, especially the price level, around the baseline. Foreign output shocks lead to a real depreciation of the rupee but their spillover effects on domestic output are rather modest. By contrast positive shocks to remittances from abroad lead subsequently to a significant increase in domestic output and a substantial real exchange rate appreciation, but very little response of the domestic price

level. As a group, external shocks explain roughly about a fifth to half of the fluctuations of domestic output around baseline at a one to two year horizon, and remittances shocks alone explain about 20 percent of the fluctuations of output at a two-year horizon. For inflation, external shocks as a group explain about 10-35 percent of the deviations around baseline. The importance of external shocks has definitely increased post-September 11, 2001. In particular, output growth in 2004 and 2005 would have been about 2½ percentage points less each in the absence of any remittance shocks after September 11.

Second, real exchange rate depreciation shocks lead to a modest fall in domestic output, indicating that depreciations are contractionary rather than expansionary. The inflation rate rises indicating some pass-through effect on prices; although the pass-through effect is fairly substantial in magnitude, it is not very precisely determined and thus statistically insignificant.

Third, turning to the transmission mechanisms, the response of net exports is more conventional—that is a rise in net exports following a real exchange rate depreciation shock. However, this is largely driven by imports falling rather than exports rising. The positive net exports effect is more than offset by a contractionary effect on domestic absorption, which is what leads to a net negative effect on output. Thus the channels of transmission are that real imports show a conventional fall following real currency depreciation, exports do not exhibit much of an expansionary response, but domestic demand falls substantially. Likely the fall in domestic demand is driven by the special problems that have been discussed in the literature in the context of developing countries such as currency mismatches on domestic balance sheets, volatile international capital flows, and a historical record of lack of credibility of macroeconomic policies.

Finally, the implications of the results for the choice of exchange rate regime are rather mixed. Several results point to a case against fixing the exchange rate: Pakistan does not share common shocks with its major trading partners and there is not much evidence that it would reap much gain in credibility of anti-inflationary policy either from fixing. Moreover, remittance shocks, which have been very volatile historically, cause fairly large fluctuations which exchange rate flexibility would help to provide an appropriate adjustment mechanism to. In addition, it appears that exchange rate flexibility would help to stabilize external imbalances as well. But working against greater flexibility of the exchange rate is the argument that the results indicate that exchange rate depreciations have substantial negative effects on domestic demand, which more than offset the positive effect on net exports. Thus, greater exchange rate flexibility may end up destabilizing rather than stabilizing aggregate output growth.

In sum, a *potential* case for greater exchange rate flexibility and the ability of exchange rate changes to act as an appropriate adjustment mechanism to shocks exists in Pakistan. But it is held back by typical problems of a developing country that lead to a (rational) "fear of floating." With Pakistan's macroeconomic policies becoming more stable over the past few years, it has had a bit more room to pursue countercyclical monetary policy and allow greater exchange rate flexibility perhaps. Other country experiences—such as Mexico's since its currency crisis of 1995—also show that, with improvement in policies and in the monetary framework, developing countries can graduate and the exchange rate can become a better adjustment tool. If the monetary framework and policies in Pakistan continue to mature further, one would perhaps in time be able to give a more unqualified recommendation for a policy of greater exchange rate flexibility.

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Table 1: Statistics of Variables in Growth Rate		
Variables	**Mean**	**Standard Deviation**
Terms of Trade	-1.10	12.20
Foreign Output	3.88	4.23
Workers' Remittances	14.18	37.45
Real Effective Exchange Rate	0.63	6.37
Real GDP domestic	5.09	1.96
Consumer Price Index	9.31	5.91
Domestic Absorption	4.95	3.08
Exports	6.37	13.01
Imports	5.25	11.79

Table 2: Results of Augmented Dickey-Fuller (ADF) Test		
Variables	**Log-Levels (with drift and trend)**	**Growth Rates (with drift only)**
Terms of Trade	-2.20	-3.01**
Foreign Output	-3.07	-3.94***
Remittances	-2.98	-2.71*
Real Effective Exchange Rate	-2.78	-3.94***
Real GDP	-1.14	-2.29
Domestic Absorption	-1.76	-3.37**
Exports	-2.87	-3.54**
Imports	-2.48	-2.72*
Consumer Price Index	-2.64	-5.60***
Note: *** indicates significant at 1 percent level of significance; ** indicates significant at 1 percent level of significance; * indicates significant at 1 percent level of significance;		

Table 3: Correlations of Reduced-form Disturbances						
Variables	Terms of Trade	Foreign Income	Remittances	Real Effective Exchange Rate	Real GDP	Consumer Price Index
Terms of Trade	1.00	0.05	-0.09	-0.04	-0.09	0.09
Foreign Output		1.00	-0.06	0.19	0.25	0.01
Remittances			1.00	-0.24	-0.13	0.02
Real Effective Exchange Rate				1.00	0.31	0.08
Real GDP					1.00	0.09
Consumer Price Index						1.00

Table 4: Variance Decomposition of the Growth of Real Effective Exchange Rate

k (years)	Percentage of the k-step ahead forecast error variance of growth of real effective exchange rate explained by							
	External shocks			Domestic shocks			All External shocks	All Domestic shocks
	Terms of Trade shock	Foreign Output shock	Remittances shock	Real Exchange Rate shock	Domestic Output shock	Domestic Price (CPI) shock		
1	4.3	7.1	7.4	81.3	0*	0*	18.7	81.3
	(5.9)	(7.8)	(7.7)	(11.3)	-	-	(21.5)	(11.3)
2	8.8	16.5	16.0	53.0	3.3	2.4	41.3	58.7
	(8.9)	(11.9)	(11.1)	(13.7)	(3.3)	(3.4)	(31.8)	(20.4)
3	10.0	31.2	16.0	37.1	2.4	3.3	57.2	42.8
	(9.1)	(13.9)	(10.9)	(11.6)	(2.1)	(3.5)	(33.9)	(17.2)

Notes: Standard errors are in parenthesis.
"0*" indicates contribution constrained to be zero as a consequence of the identification assumptions.

Table 5: Variance Decomposition of the Growth of Domestic Output

k (years)	Percentage of the k-step ahead forecast error variance of growth of domestic output explained by							
	External shocks			Domestic shocks			All External shocks	All Domestic shocks
	Terms of Trade shock	Foreign Output shock	Remittances shock	Real Exchange Rate shock	Domestic Output shock	Domestic Price (CPI) shock		
1	4.6	9.7	4.4	7.6	73.8	0*	18.6	81.4
	(6.0)	(9.5)	(5.7)	(7.5)	(13.0)	-	(21.3)	(20.5)
2	7.3	11.4	6.8	23.4	45.9	5.2	25.5	74.5
	(7.4)	(9.2)	(6.5)	(10.4)	(11.6)	(5.8)	(23.0)	(27.8)
3	8.3	15.9	19.9	11.1	19.0	25.7	44.2	55.8
	(7.8)	(10.9)	(12.1)	(6.0)	(6.9)	(11.0)	(30.8)	(24.0)

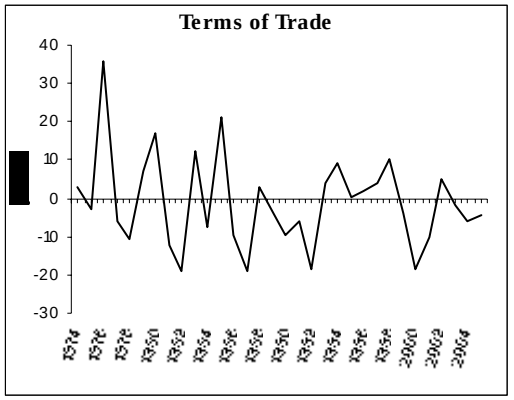
Notes: Standard errors are in parenthesis.
"0*" indicates contribution constrained to be zero as a consequence of the identification assumptions.

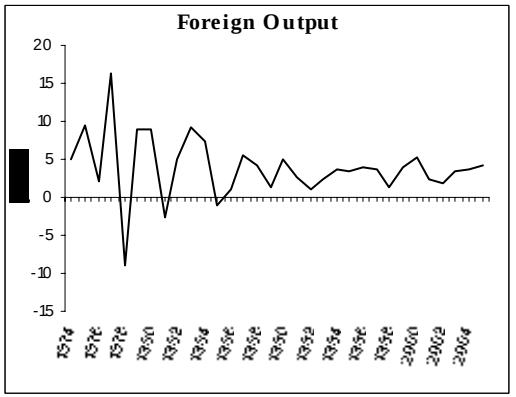
Table 6: Variance Decomposition of Domestic CPI Inflation

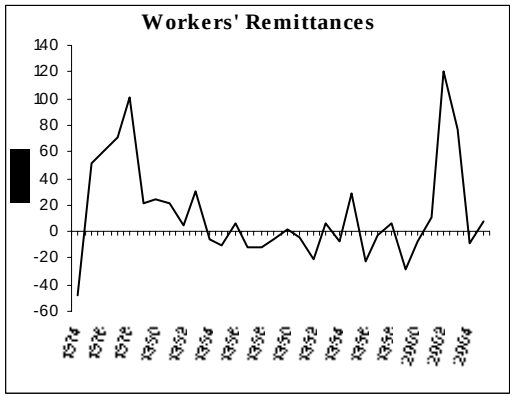
k (years)	Percentage of the k-step ahead forecast error variance of growth of CPI Inflation explained by							
	External shocks			Domestic shocks			All External shocks	All Domestic shocks
	Terms of Trade shock	Foreign Output shock	Remittances shock	Real Exchange Rate shock	Domestic Output shock	Domestic Price (CPI) shock		
1	5.0	3.5	3.5	4.0	3.2	80.8	12.0	88.0
	(6.7)	(4.5)	(5.0)	(5.2)	(4.3)	(10.6)	(16.1)	(20.1)
2	12.9	7.6	8.5	4.5	3.2	63.4	28.9	71.1
	(11.3)	(7.7)	(8.1)	(5.1)	(3.9)	(13.3)	(27.1)	(22.3)
3	15.0	10.1	9.8	7.2	3.4	54.5	34.9	65.1
	(12.3)	(9.3)	(7.9)	(6.6)	(3.8)	(14.0)	(29.5)	(24.5)

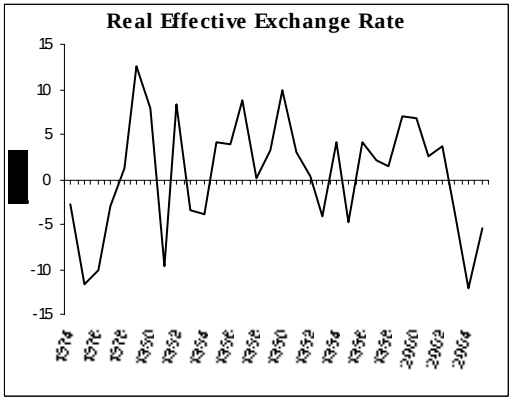
Notes: Standard errors are in parenthesis.

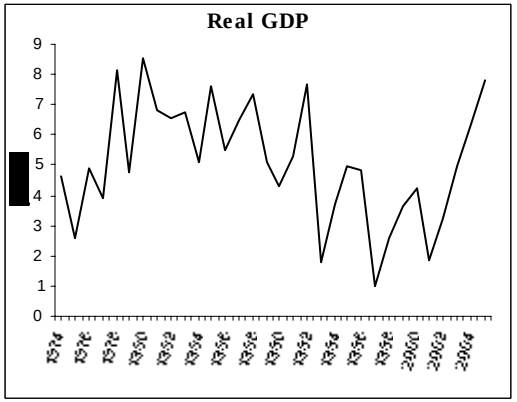
Figure 1: Plots of Variables in Growth Rates

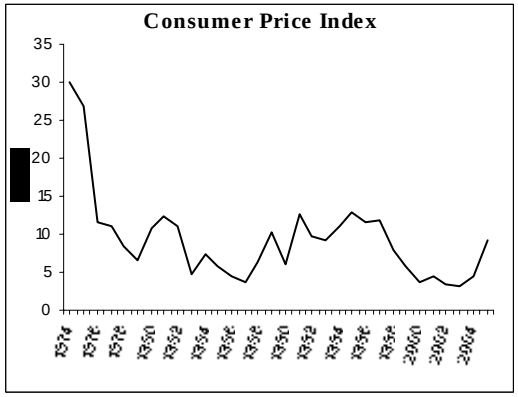


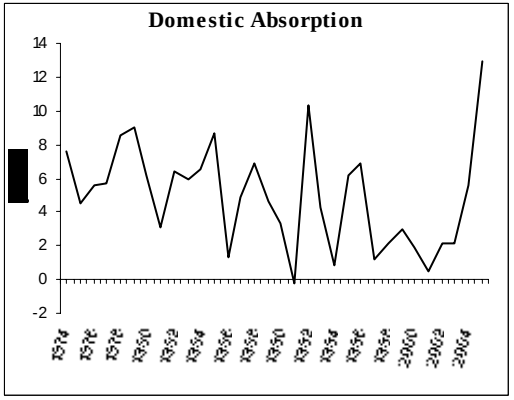


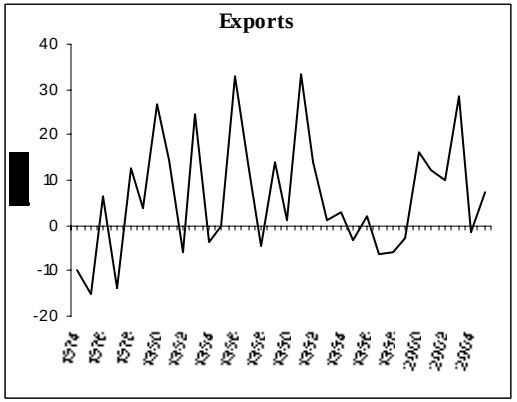












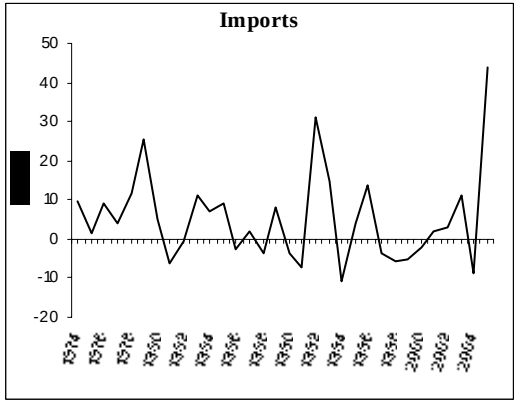
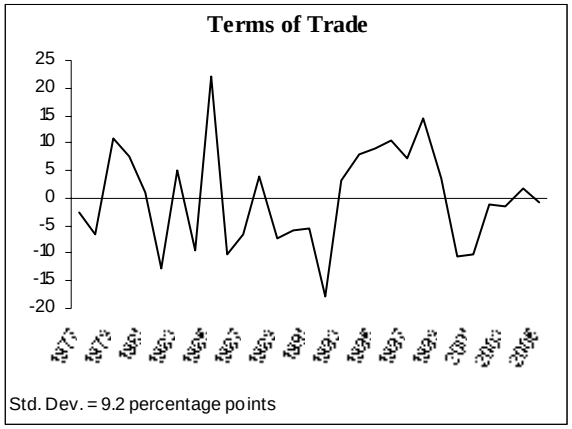
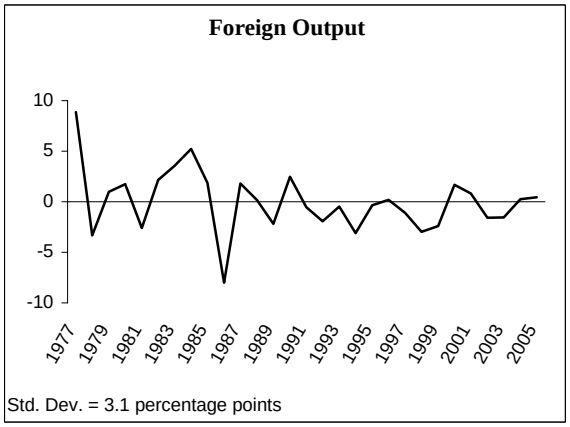
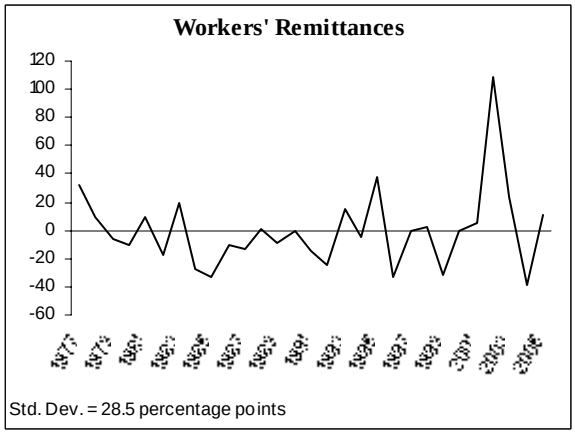
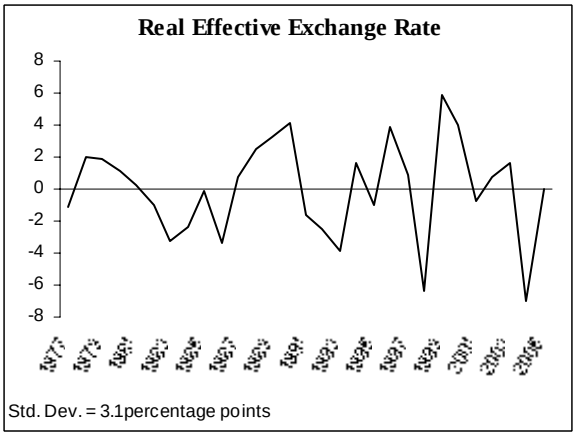


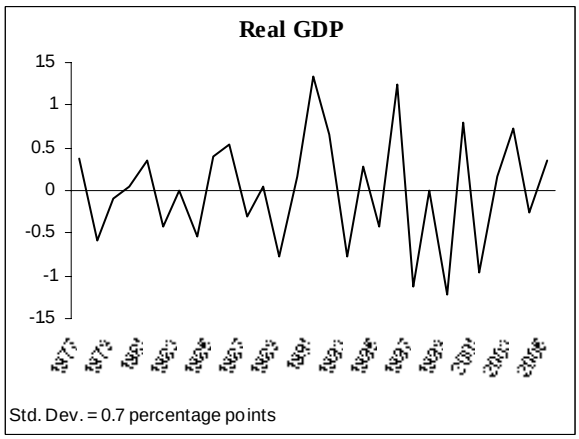
Figure 2: Plots of Fundamental Disturbances











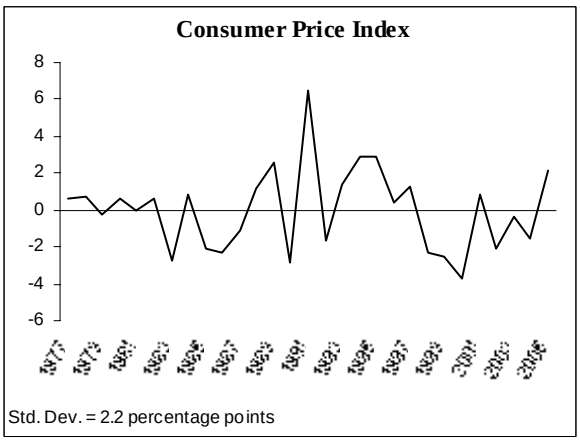
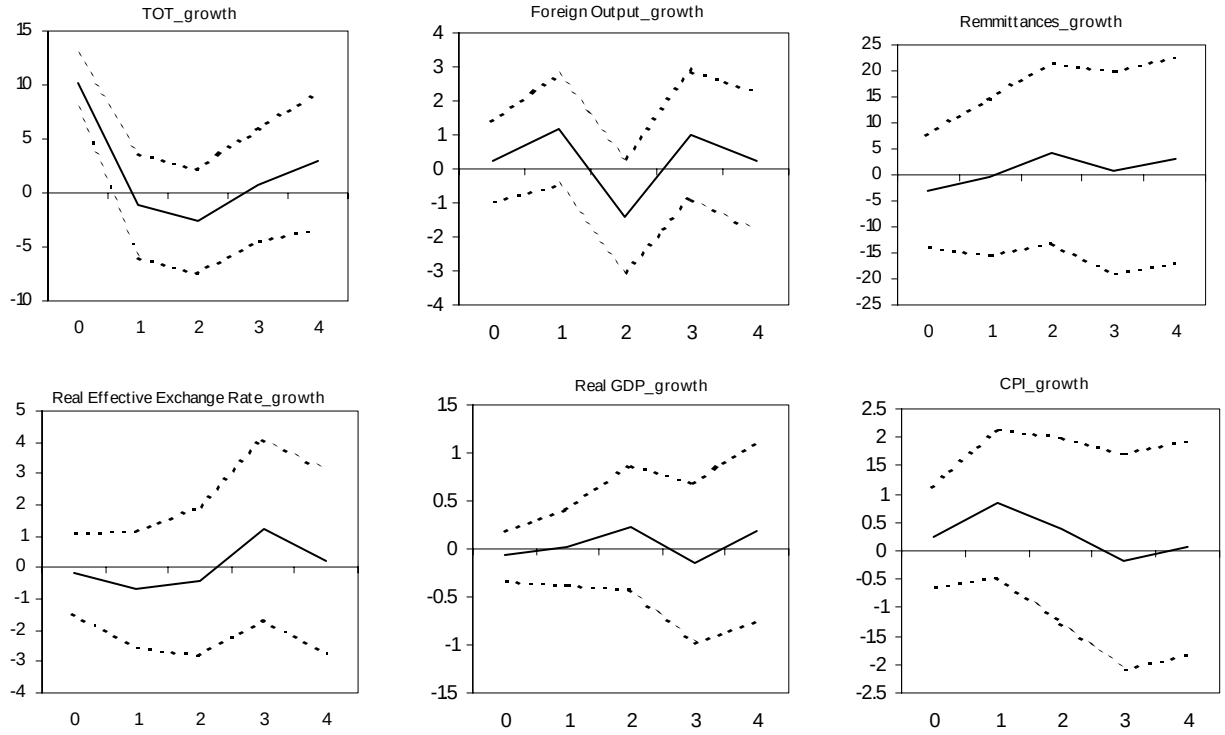


Figure 3: Responses to a shock to Terms of Trade

(in Growth Rates)



(in Levels)

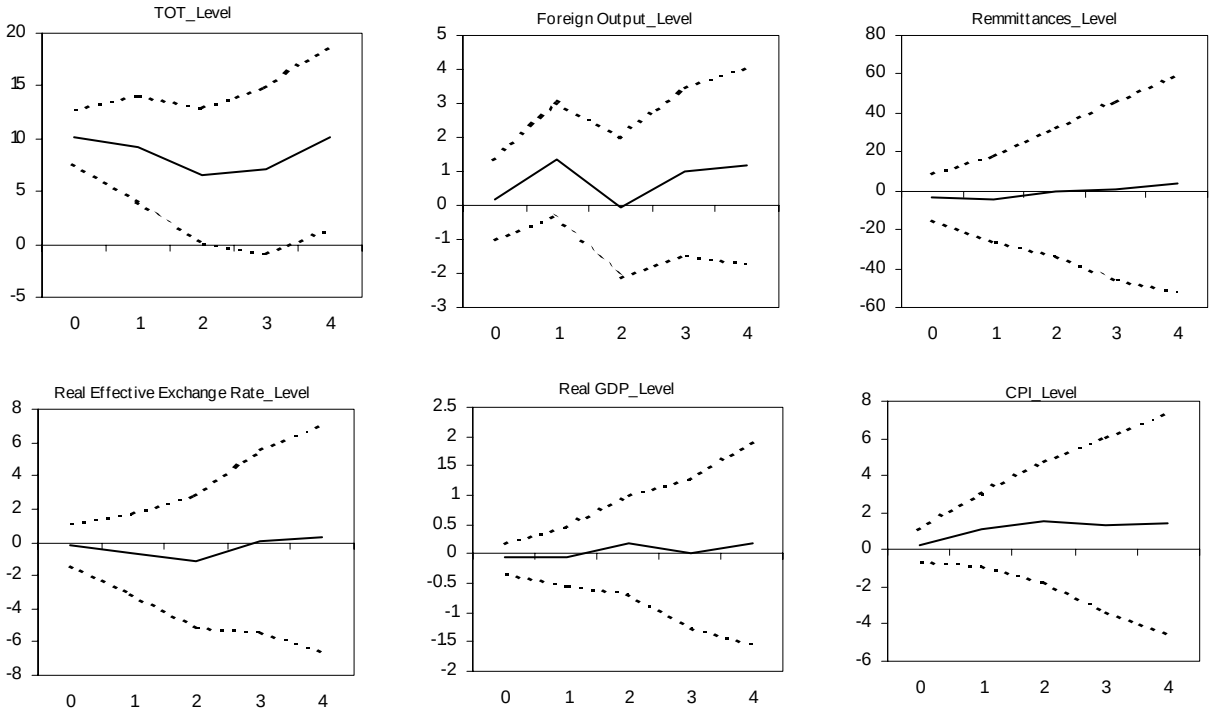
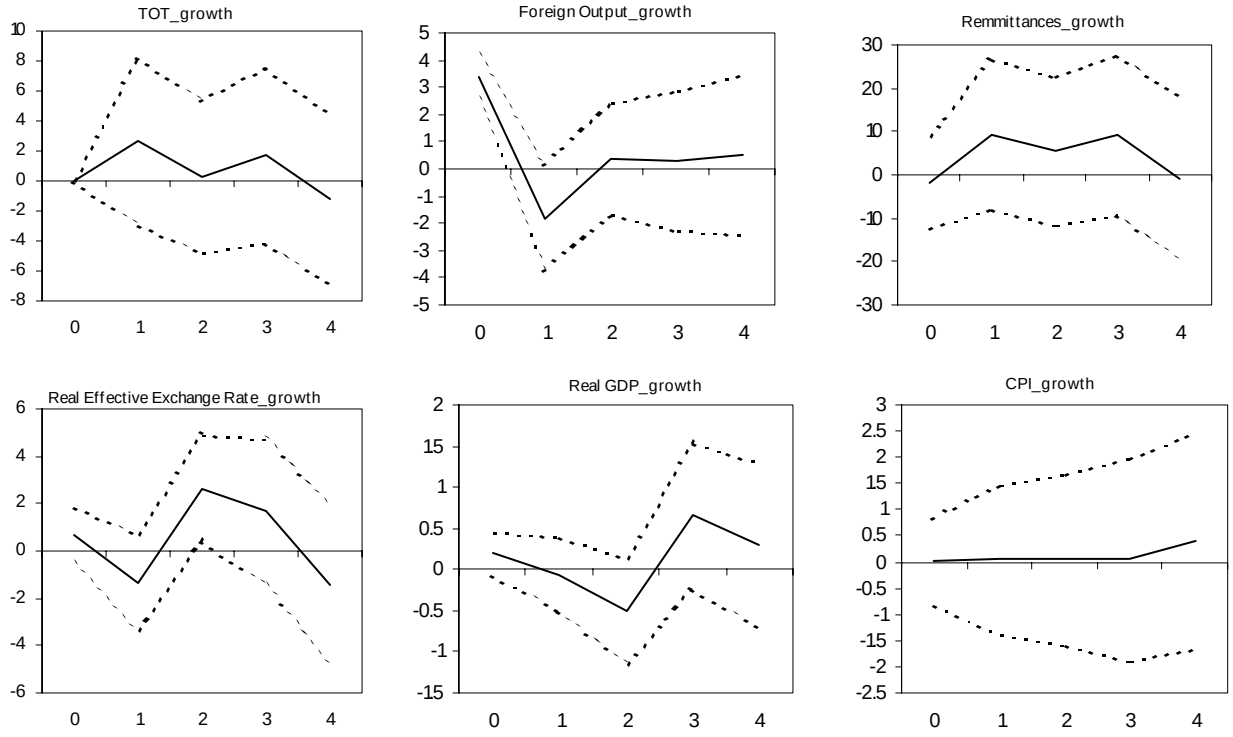


Figure 4: Responses to a shock to Foreign Output

(in Growth Rates)



(in Levels)

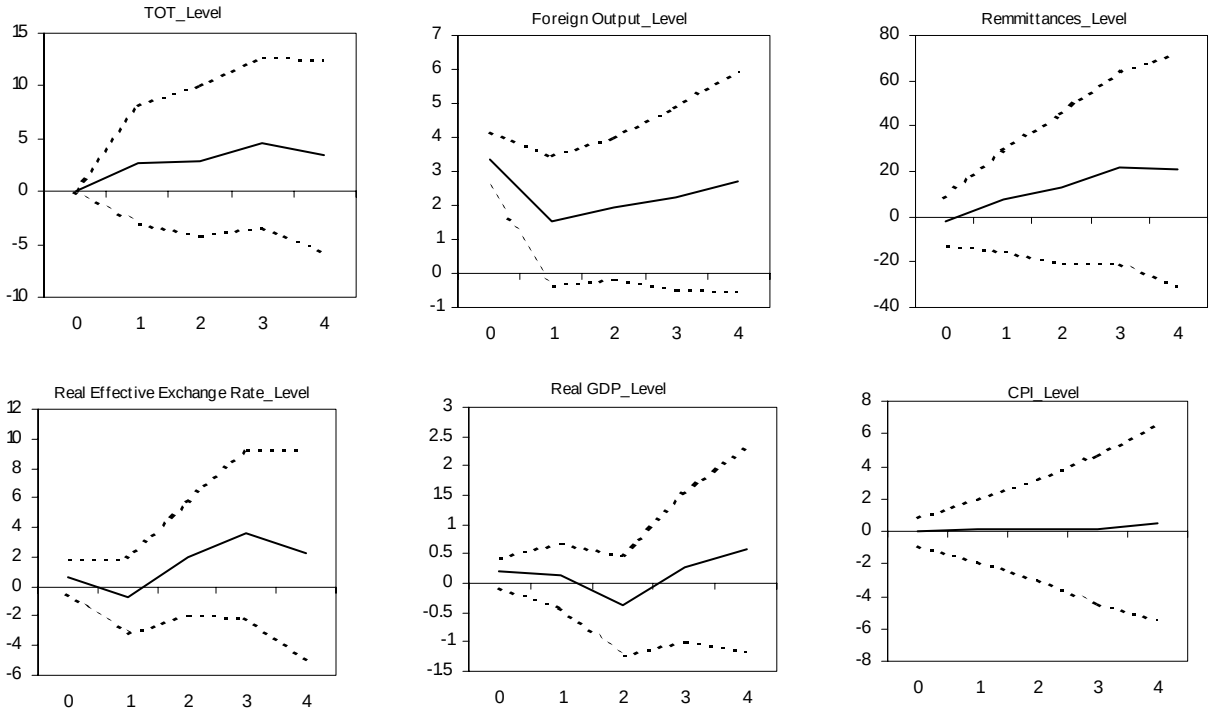
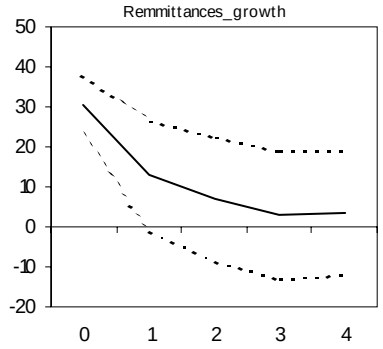
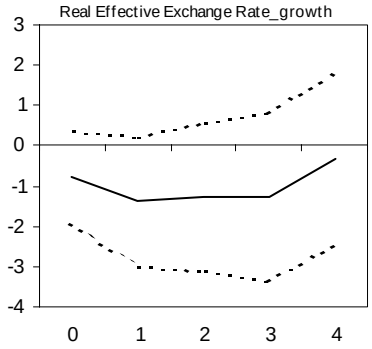
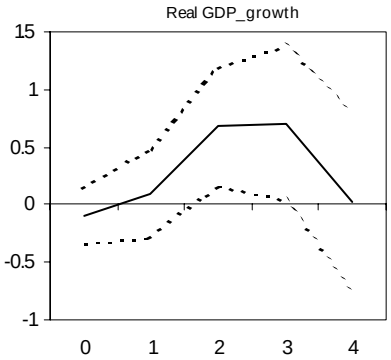


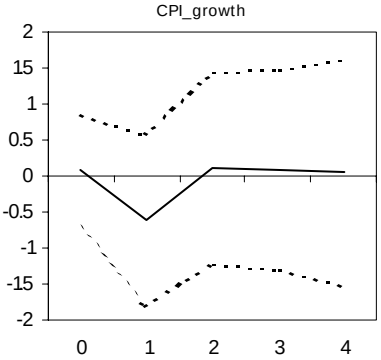
Figure 5: Responses to a shock to Workers' Remittances

(in Growth Rates)









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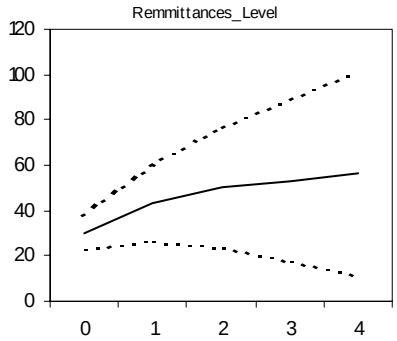
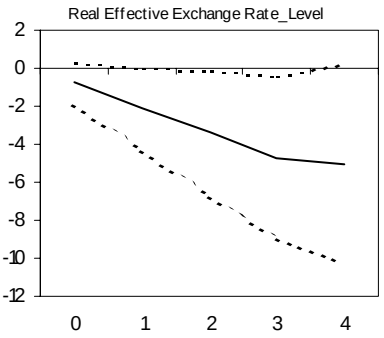
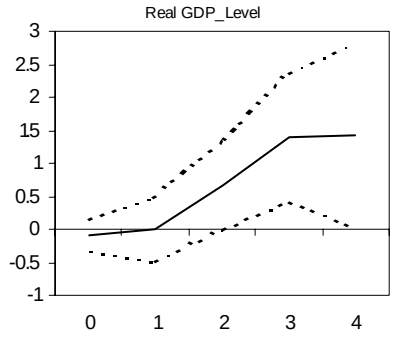






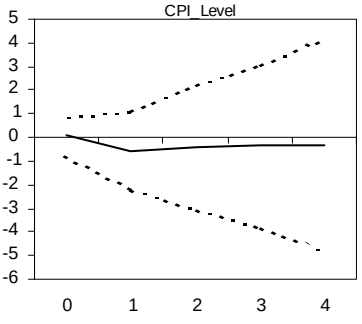
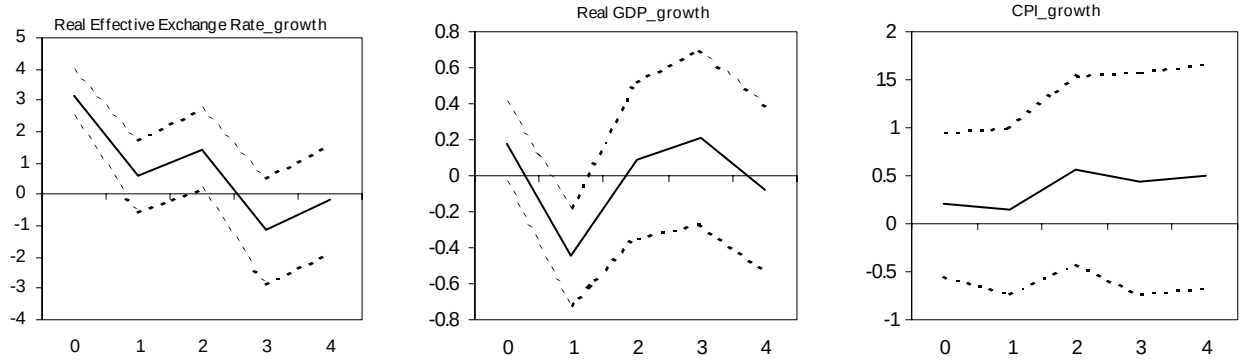


Figure 6: Responses to a shock to Real Effective Exchange Rate

(in Growth Rates)



(in Levels)

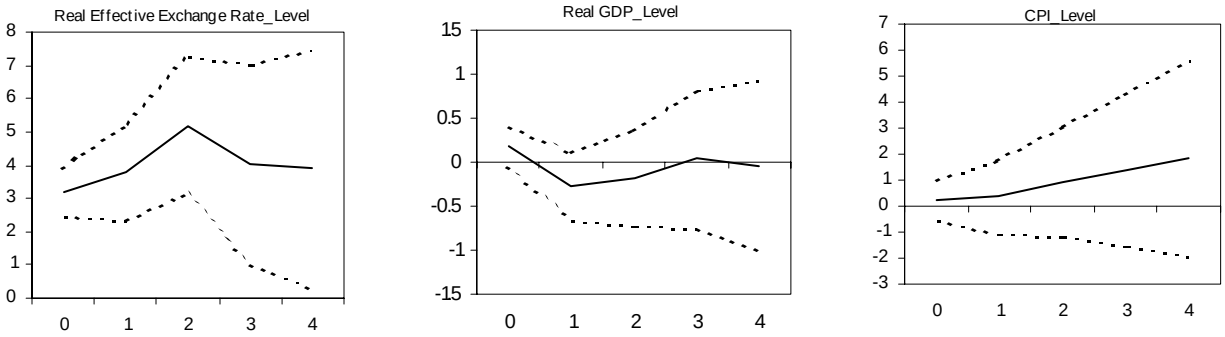
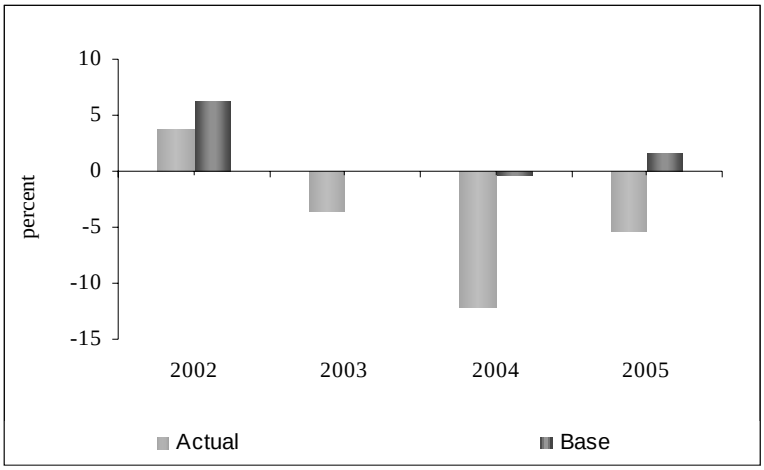
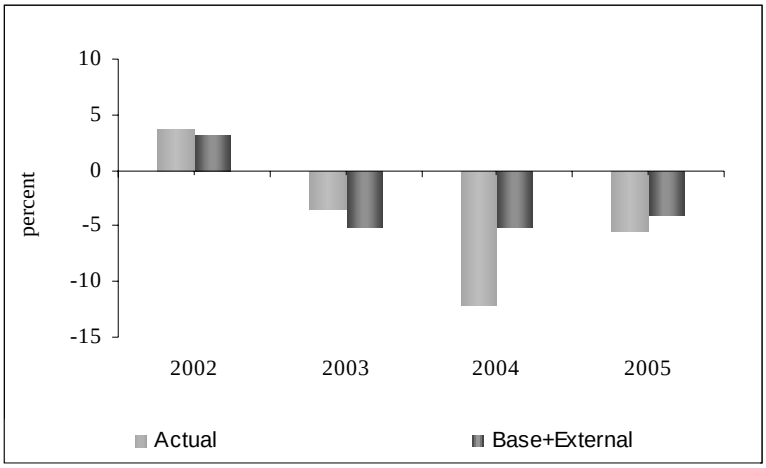


Figure 7: Historical Decomposition of Growth of Real Effective Exchange Rate





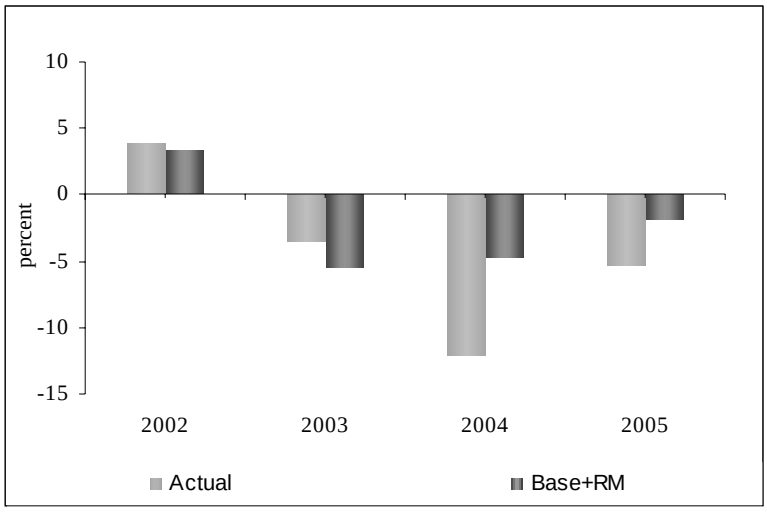
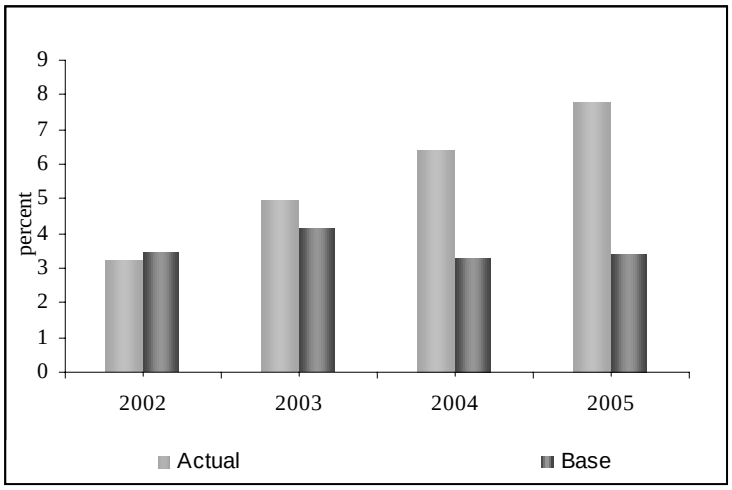
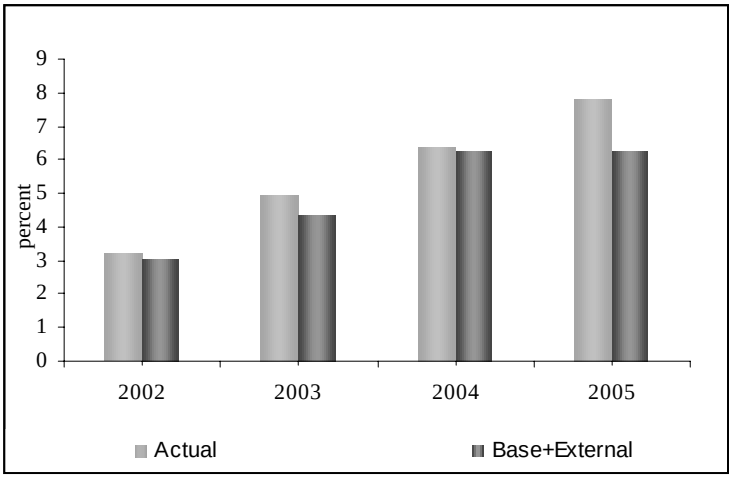


Figure 8: Historical Decomposition of Growth of Domestic Output





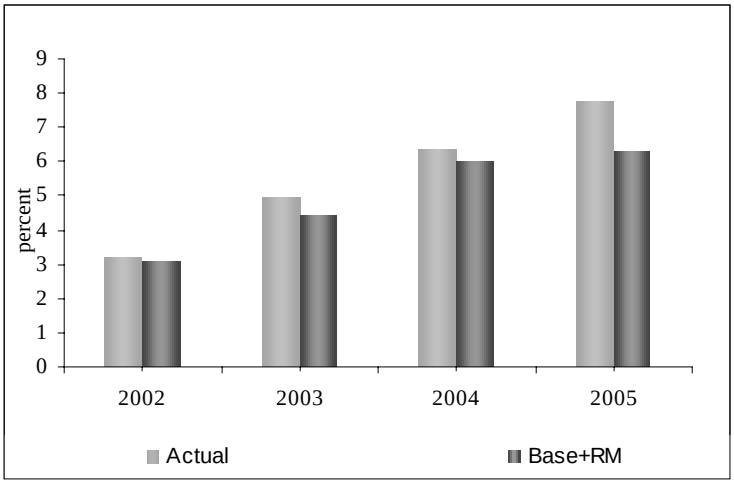
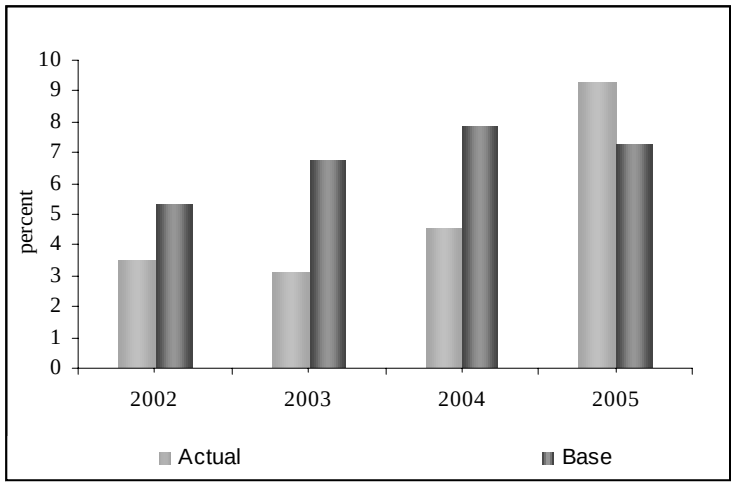
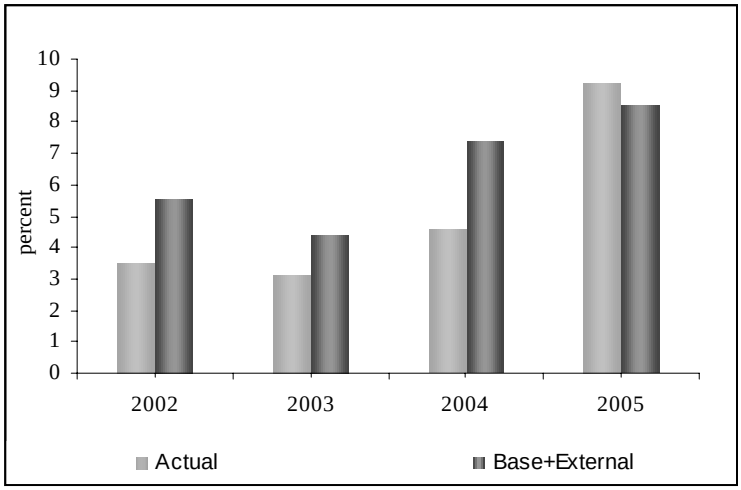


Figure 9: Historical Decomposition of Domestic CPI Inflation





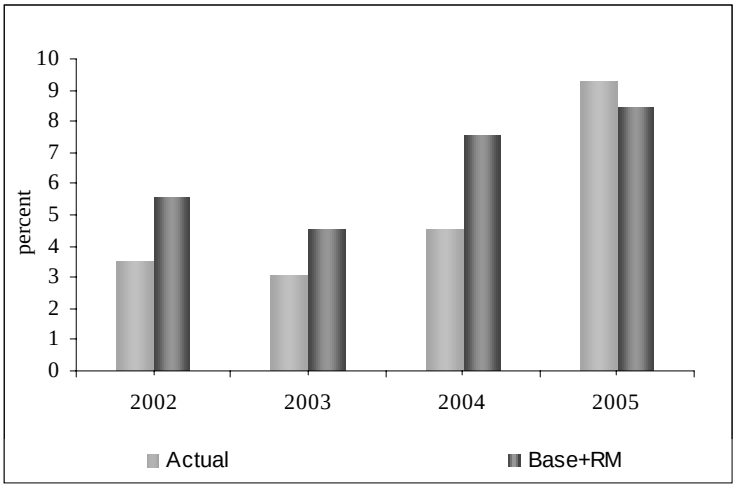
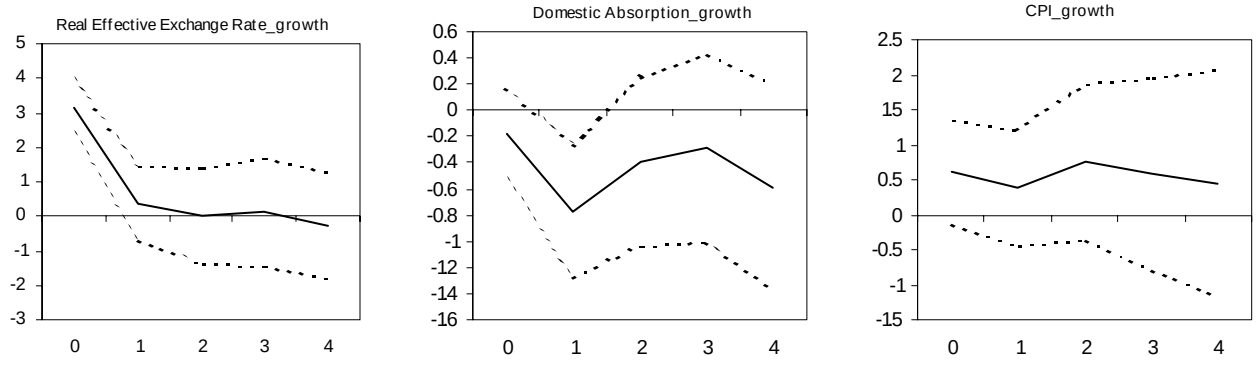


Figure 10: Responses to a shock to Real Effective Exchange Rate (Absorption Model)

(in Growth Rates)



(in Levels)

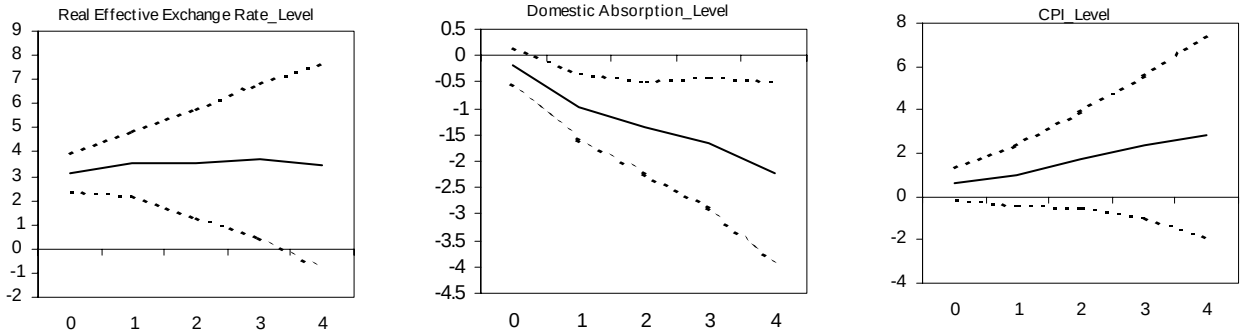
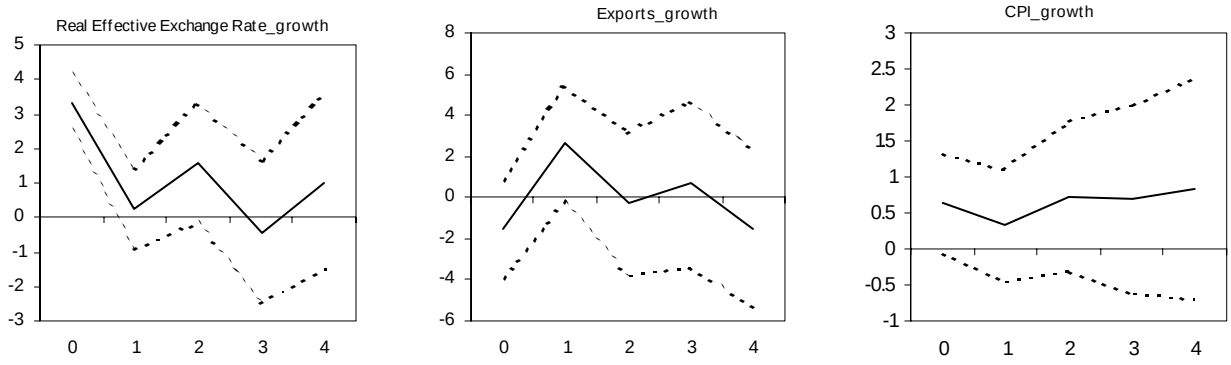


Figure 11: Responses to a shock to Real Effective Exchange Rate (Export Model)

(in Growth Rates)



(in Levels)

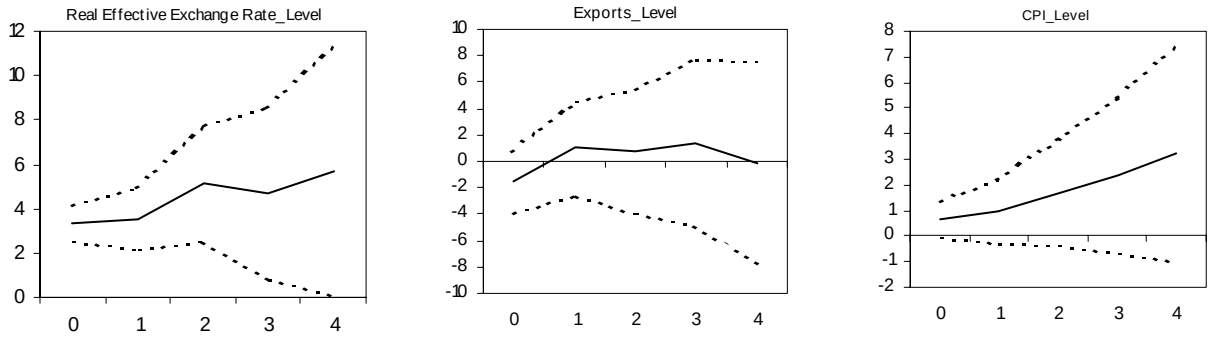
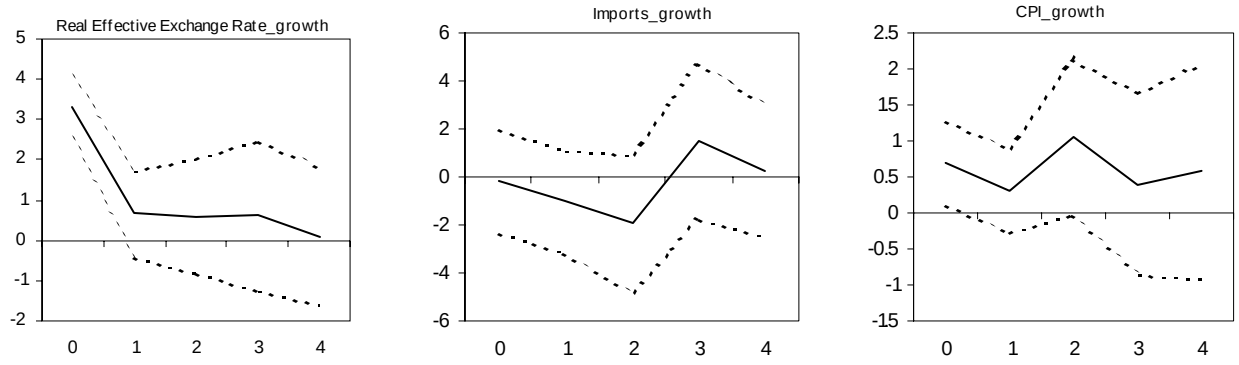


Figure 12: Responses to a shock to Real Effective Exchange Rate (Import Model)

(in Growth Rates)



(in Levels)