# Exchange Market Pressure and Monetary Policy: Pakistan's Experience

**By**

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# Table of Contents

# Tables

## Figures

## Abbreviations

| | |
|---|---|
| ADB | Asian Development Bank |
| BOP | Balance of Payments |
| CPI | Consumer Price Index |
| DFI | Development Financial Institution |
| DHF | Dicky, Haza and Fuller |
| EBS | Export Bonus Scheme |
| emp | Exchange Market Pressure |
| ER | Exchange Rate |
| FCA | Foreign Currency Account |
| FCD | Foreign Currency Deposit |
| FDI | Foreign Direct Investment |
| FIBs | Federal Investment Bonds |
| FY | Financial Year |
| GDP | Gross Domestic Product |
| GNP | Gross National Product |
| GTDR | General Treasury Depository Receipts |
| HEGY | Hyllerberg, Engle, Granger and Yoo |
| IFS | International Financial Statistics |
| IMF | International Monetary Fund |
| IRF | Impulse Response Function |
| KE | Kamaly and Erbil |
| LHS | Left Hand Side |
| MABOP | Monetary Approach to Balance of Payments |
| MENA | Middle Eastern North African |
| NATREX | Natural Real Exchange Rate |
| NCCC | National Credit Consultative Council |
| NDA | Net Domestic Assets |
| NFA | Net Foreign Assets |
| NRFCD | Non-Resident Foreign Currency Accounts |
| OGL | Open General License |
| OLS | Ordinary Least Square |
| OMO | Open Market Operation |
| PIBs | Pakistan Investment Bonds |
| PPP | Purchasing Power Parity |
| Pr. | Premium |
| REPO | Repurchase |
| RFCD | Resident Foreign Currency Deposits |
| RHS | Right Hand Side |
| RS. | Rupee |
| RSS | Residual Sum of Squares |
| SAP | Structural Adjustment Programme |
| SBP | State Bank of Pakistan |
| SLR | Statutory Liquidity Reserve |
| T-Bills | Treasury Bills |

| | |
|---|---|
| TFCD | Total Foreign Currency Deposits |
| UIP | Uncovered Interest Parity |
| UK | United Kingdom |
| US | United States |
| VAR | Vector Autoregression |
| VMA | Vector Moving Average |

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M. Idrees Khawaja

## Abstract

**Exchange Market Pressure and Monetary Policy: Pakistan's Experience**

The term 'Exchange market pressure' generally refers to the magnitude of money market disequilibrium arising from international excess demand/supply of domestic currency. Girton and Roper (1977) specifically, define exchange market pressure (*emp*) as sum of exchange rate depreciation (in percent) and depletion of foreign reserves (scaled by monetary base). Under Managed float the monetary authority has the option to adjust the exchange rate or foreign reserves to restore the equilibrium in money market. In practice, quite often the adjustment is shared between foreign reserves and exchange rate. Therefore, under managed float, combined variations (i.e. *emp*) in foreign reserves and exchange rates represent an important transmission mechanism for restoration of equilibrium in money market. In this regime, to study money market disequilibrium a focus on either exchange rate or foreign reserves to the complete exclusion of the other would convey a misleading picture of external account. Therefore, under managed float, to examine money market disequilibrium and draw policy implications, the focal point should be *emp* as it incorporates the changes in exchange rate as well as variations in foreign reserves.

The objectives of the study are: (i) to analyze the nature of relationship between exchange market pressure and monetary variables *viz*. domestic credit and interest rate; (ii) to identify the monetary tool(s) used to manage exchange market pressure; and (iii) to determine the degree of monetary autonomy enjoyed by State Bank of Pakistan (SBP). The study is focused exclusively on Pakistan.

Our results show; that the relationship between exchange market pressure and monetary variables is positive. The relationship between interest rate nad exchange market pressure is much weaker as compared to the relationship between domestic credit and exchange market pressure. Results from vector autoregression as well as Granger causality imply that domestic credit and not interest rate, has remained the dominant tool of monetary policy during the span examined (1991:04-2005:12). However, during the active life of foreign currency accounts (1991:03-1998:05) interest rate has been used to defend the Rupee. Finally the results show that the extent of monetary autonomy enjoyed by SBP has remained highly restricted.

# 1 Introduction

Defining and measuring pressure on fixed exchange rate constitute an important part of the vast analytical and empirical literature on currency crises and speculative attacks. The majority of the empirical studies do not directly employ any empirical model.[1] The concept of excess demand for/excess supply of money has been used to lesser extent for measuring exchange market pressure (*emp*) and for determining the degree of central bank intervention under managed float. The seminal work in this respect is of Girton and Roper (1977). The literature on *emp*, under managed float, can classified under the lead of Girton and Roper (1977), Weymark (1995, 1998) and Eichengreen, Rose and Wyplosz's (1995), each one using a different approach. All the three approaches have been discussed in chapter 3.

## 1.1 Significance of the study

Generally, the disequilibrium in money market creates exchange market pressure. Specifically, exchange market pressure is defined as sum of exchange rate depreciation and foreign reserves outflow, scaled by monetary base. Knowledge of mechanism and instruments that restore the money market equilibrium has important policy implications[2]. Monetary approach to balance of payments and monetary approach to exchange rate have, traditionally, been used to explain as to how money market equilibrium, once disturbed, is restored.

Under the monetary approach, if the fixed exchange rate regime prevails, then any excess supply or demand for money will be corrected by an outflow or inflow of foreign reserves. Increase in money supply causes the expenditure to increase and given domestic output at full employment level, the increased demand is satisfied through imports that cause the foreign reserves to deplete. Depletion of reserves restores the money market equilibrium as the newly created money flows out. Similarly in case of excess demand for money the exports restore the equilibrium.

[1] See Kaminsky, Lizando and Reinhart (1998) for an exhaustive bibliography

[2] For example the lags involved in transmission of monetary policy changes to real economic activity vary for different transmission channels. This influences the choice of the exact time period as to when a change in monetary policy should be given effect to generate impact at some predetermined time.

On the other hand if the floating exchange rate regime prevails, then central bank intervention being absent, exchange rates adjust to correct any disequlibrium in money market. The free market equilibrium exchange rate occurs at a point where the flow of exports equals the flow of imports so that no net foreign reserve flows are required.

Managed float exchange rate regime that currently prevails, in most of the countries, involve changes in exchange rate as well as variations in foreign reserves. monetary approach to balance of payments and monetary approach to exchange rate with their exclusive focus on a single variable *viz*. foreign reserves and exchange rate respectively, are less suitable, if not entirely inappropriate, to study equilibrium restoration process under managed float.

Therefore a composite variable that incorporates changes in exchange rate and variations in foreign reserves is needed that could be focused upon to examine the money market's equilibrium restoration process/instruments. Exchange market pressure, as defined above, is that composite variable.

The objectives of the study are: (i) to analyze the nature of relationship between exchange market pressure and monetary variables *viz*. domestic credit and interest rate; (ii) to identify the monetary tool(s) used to manage exchange market pressure; and (iii) to determine the degree of monetary autonomy enjoyed by State Bank of Pakistan (SBP). The study is focused exclusively on Pakistan.

The motivation for the objectives of the study is discussed below. This study takes the view that under managed float exchange rate regime, which is widely practiced around the world, the foregoing practice is flawed. The reason being that in face of central bank intervention in forex market, exchange rate depreciation/appreciation can be partially avoided or at least delayed at the cost of corresponding changes in foreign reserves. For example if the central bank sells foreign currency, in the domestic forex market, from its stock of foreign reserves this would increase supply in the forex market. The increase in supply in this manner can stall or at least delay the exchange rate depreciation warranted by market forces, but only at the cost of depletion of foreign reserves. Similarly the central bank can decrease the supply in the forex market by buying foreign currency in exchange for domestic currency. This managed decrease in supply of foreign currency will curb the appreciation of exchange rate, but will

simultaneously cause an increment in foreign reserves. The foregoing makes it explicit that changes in exchange rate and variation in foreign reserves are the two sides of the same coin—hide one and the other shows up. Therefore to characterize the external account situation, under managed float exchange rate regime, it becomes essential to have a composite variable that incorporate changes in exchange rate as well as variation in foreign reserves. This study, by using a time series of exchange market pressure (*emp*) allows an all-inclusive view of external account situation. So far, to the best of our knowledge this has not been done, for Pakistan.

This study, for reasons outlined earlier, uses the composite variable (*emp*) rather than foreign reserves or exchange rate, to study interaction between monetary variables and external account. Specifically the study examines the nature of influence of monetary variables *viz*. domestic credit and interest rate upon (*emp*) and vice versa. This analysis is likely to facilitate monetary management.

Another objective of the study is to find out whether the monetary authority uses the instrument of domestic credit or interest rate to tackle exchange market pressure. The use of domestic credit implies quantitative monetary management i.e. directly varying the level of money supply whereas the use of interest rate implies market-based monetary management. The two types of monetary management have different implications for the economy. Policy statements emanating State Bank of Pakistan claim that monetary policy has moved from direct quantitative management to market-based management in 1990s and that now monetary management is completely market-based. Some analyst, dispute the claim. The study will furnish an empirical test of the claim.

Last but not the least objective of the study is to examine the degree of monetary autonomy enjoyed by authorities. In layman terms monetary autonomy may be defined as the ability of authorities to determine the level of money supply on their own without subscribing to influence of any kind. In technical terms the issue is whether the money supply is exogenous or endogenous. Under fixed exchange rate regime, given perfect capital mobility, any increase in domestic money stock is offset by a corresponding decrease in foreign reserves and vice versa. Thus the authority cannot independently determine the quantity of money supply i.e. the authority does not enjoy monetary independence or in other words money supply is exogenous. On the other hand, under

floating exchange rate regime, the money market disequilibrium is restored through changes in domestic price level and variations in exchange rate (rather than reserves). As the foreign reserves remain unaffected by exogenous change in money supply, therefore the overall money supply increases/decreases. Thus under floating exchange rate regime the authority can independently determine the level of money supply i.e. the authority enjoys monetary independence or in other words money supply is endogenous. The fact that managed float is nothing but a synthesis of fixed and floating regime, brings us to the question of the extent of freedom enjoyed by the monetary authority in determining the level of money supply i.e. what is the degree of monetary autonomy.

The need to examine the degree of monetary independence arises because the policy response to exchange market pressure among other things depends upon the degree of monetary independence enjoyed by the authorities. According to Kamaly and Erbil (2001), in case of low level of monetary autonomy, the authority has to vigorously use its monetary instruments for them to have concrete effect on exchange market pressure, because most of the impact is offset. In contrast, in case of high degree of monetary autonomy, small changes in policy instruments can achieve desired objectives. Hence the knowledge of degree of monetary independence is important to devise an appropriate policy response to exchange market pressure. Besides the degree of monetary autonomy has repercussion for the level of inflation and economic growth rate.

The study adds to the literature in the sense that it's the first of its kind to be exclusively focused on Pakistan. At empirical level, unlike earlier studies it recognizes that Purchasing Power Parity does not hold and therefore includes deviation from PPP as an independent variable that may influence exchange market pressure. The study, at empirical level, also includes real income as an explanatory variable that the earlier studies exclude for want of data at monthly frequency. This study also uses monthly data but allows for real income to influence exchange market pressure through the use of a proxy *viz*. industrial production. Here it is note worthy that industrial production, over the period 1999-00 to 2005-06, has on average comprised 25 percent of real income, and is therefore an imperfect proxy, but given the data available, at monthly frequency, this is the best proxy available.

## 1.2 Organization of the study

Rest of the study is organized as follows: Chapter two, discusses the theories underlying the concept of exchange market pressure.These include monetary approach to balance of payments, monetary approach to exchange rate and the theory of purchasing power parity the deviation from which is used as an independent variable in our empirical model. Chapter 3 presents the literature on exchange market pressure. Chapter 4 develops the theoretical framework of the empirical model employed in the study and chapter 5 presents the empirical model itself. Chapter 6 presents the data used in the study and the statistical tests employed to determine the suitability of the data for empirical investigation. Chapter 7 briefly reviews the macroeconomic history of Pakistan and chapter 8 thoroughly analyzes the key variables that had cast an impact on exchange market pressure. Chapter 9 presents and analyzes empirical results. Chapter 10 concludes the study.

# Literature Review-I

# 2 Underlying Theories

Exchange market pressure essentially represents disequilibrium in money market. Monetary approach to Balance of Payments and Monetary approach to exchange rate have been, traditionally, used to examine the disequilibrium in money market. The two approaches are discussed in this chapter. Besides, as described later on, 'deviation from purchasing power parity' is an independent variable in our theoretical and empirical model. The purchasing power parity theory is also discussed in this chapter.

## 2.1 Monetary Approach to Balance of Payments

### 2.1.1 Definitions

Balance of Payments (BOP)

Balance of payments (BOP) is a statistical record of all economic transactions between the residents of the reporting country and residents of rest of the world, during a give time period, usually a year.

Balance of payments comprises, following sub-accounts

Current Account

Current account represents the difference between 1) receipts for import of goods and payments for import of goods (trade balance), 2) receipts for export of services and payments for import of services (invisible account) and unrequited (i.e. unilateral) transfers.

Capital Account

Difference between capital inflows & outflows is called capital account balance. Capital inflows due to foreign borrowings, sale of overseas assets and investments by foreigners, whether direct or portfolio. Capital outflows by way of lending abroad, purchase of overseas assets and investments abroad by residents.

Autonomous items

Transactions that take place independently of BOP e.g. receipts from exports.

Accommodating items

Transactions, that finance any difference between autonomous receipts & autonomous payments e.g. borrowings from IMF.

BOP Surplus/Deficit

Surplus = Autonomous receipts **>** Autonomous payments

Deficit = Autonomous receipts **<** Autonomous payments

### 2.1.2 Monetary Approach: An exposition

The fundamental basis of monetary approach is that balance of payments (i.e. BOP deficit or surplus) is essentially a monetary phenomenon. The approach assumes; a stable demand for money function, full-employment and that the purchasing power parity (PPP) holds. Marina Whitman (1975), Jacob Frenkel & Harry Johnson (1976) pioneered the approach. The monetarists view BOP surpluses/deficits as monetary flows due to stock disequilibrium in money market. Overall BOP can be thought of as consisting of current account balance, the capital account balance and the change in authority's foreign reserves. That is:

$$BOP = CA + K + \Delta R = 0 \qquad (2.1)$$

Or

$$CA + K = -\Delta r \qquad (2.2)$$

Where CA is the current account balance, K is the capital account balance and ΔdR is the change in authority's foreign reserves.

Monetarists postulate that there is always a tendency towards stock equilibrium in money market i.e. towards equality of demand for money ($M^d$) and supply of money ($M^s$)

$$M^d = M^s \qquad (2.3)$$

Or

$$M^d = m(D + R) \qquad (2.4)$$

Where m is money multiplier, D is domestic component of monetary base and R is foreign component of monetary base. Assuming for simplicity a constant money multiplier, changes in demand for money and the domestic component of monetary base are the active ingredients that cause disequilibrium in money market. The change in foreign component of monetary base restores the equilibrium. Such change, viz. (ΔR) constitutes the balance of payments deficit or surplus.

The equilibrating factor that restores equilibrium is ΔR, the foreign component (foreign reserves) of monetary base. This adjustment takes time. Monetarists do not specify the length of time required for full money market equilibrium to be restored. A surplus or deficit in BOP reflects stock disequilibrium. A surplus occurs when demand for monetary balances exceeds the supply of money stock. If the excess demand is not satisfied domestically (i.e. by increase in D or by increase in m) funds are attracted from abroad to satisfy the excess demand for money stock. Such an inflow can be generated by surplus on commodity trade or service account, by FDI or foreign portfolio investment. Precise composition is immaterial for monetary approach; the important thing is that excess demand for money stock generates BOP surplus.

The assumption that demand function for money relates to money as stock and not as flow, ensures that BOP surplus is temporary and self-correcting. When the desired stock is reached (due to inflow of foreign funds) the inflow stops and therefore the BOP surplus ceases. Under two situations the surplus could be more than temporary could. First, when official sterilization (i.e. decrease in D in response to increase in R) prevents the money stock from reaching the desired level. Second, continuous increase in $M^d$ over and above the domestic component of money supply can cause persistent surplus. Such an increase can be brought about by continuous increase in money income in excess of growth rate of money supply.

Monetary approach offers the following explanation for BOP deficit. When money supply exceeds money demand, people try to get rid of their excess money balances by importing foreign goods and services (assuming full employment at home) or by acquiring overseas assets. Thus the deficit is viewed as spillover of the excess money supply: its composition is immaterial. The deficit lasts only till the excess supply is dissipated abroad. Continuous deficit is possible only if a policy of complete sterilization

is practiced (i.e. increase in D in response to decrease in R) or the money supply continues to grow in excess of the growth rate of money income. The self-correcting mechanism outlined above takes time. Except for a hint that the equilibrium restoration process may last from a year to a decade, the monetary approach is silent on the elapsed time required to reach it.

### 2.1.3 Shocks to BOP: Equilibrium Restoration Mechanics

The effects of various shocks to BOP and the mechanism that restore the money market equilibrium are discussed below.

*Devaluation*

The immediate effect of devaluation is to make domestic goods cheaper for foreigners i.e. more competitive, causing improvement in BOP. As the domestic goods become more competitive demand for domestic currency increases. Due to increase in money demand the domestic currency tends to appreciate. To prevent appreciation the authority has to purchase foreign currency with newly created domestic money base. This raises aggregate demand which, given full employment, causes domestic price level to rise. The rise in domestic price level restores the PPP and the real money balances to their pre-devaluation level. Thus with the rise of the price level money market equilibrium is restored and the competitive advantage gained due to devaluation is offset. This shows that the surplus resulting from devaluation is merely a transitory phenomenon. The important message of devaluation approach is that exchange rate changes are incapable of bringing about a lasting change in BOP.

*Money Supply expansion*

Monetary approach holds that whenever money market equilibrium is disturbed it is restored on its own, if left to market forces. However as, under fixed exchange rate regime the authority intervenes in the foreign exchange market, therefore the restoration mechanism is different under fixed and floating exchange rate regimes. Under fixed regime the disequilibrium is restored via adjustment in reserves while under floating regime the adjustment burden falls on domestic price level and exchange rates. The mechanism under the two alternate regimes is outlined below.

*Money supply expansion - Fixed exchange rate Regime*

Expansion in domestic money supply causes money supply to exceed money demand. Residents, to reduce their excess real balances, increase aggregate demand. This, given full employment, puts pressure on domestic price level. The increase in domestic prices makes the domestic economy less competitive. Consequently exports fall, imports rise and the BOP worsens. Demand for domestic currency falls and therefore it tends to depreciate. To prevent depreciation the authority intervenes by purchasing domestic currency in exchange for foreign reserves. Thus the reserves decline and money market equilibrium is restored as the newly created money is sucked back. The net effect of the money supply expansion, under fixed exchange rate regime, is the worsening of BOP.

*Money Supply expansion – Floating exchange rate regime*

Under floating regime, as the aggregate demand rises upon money supply expansion, given full employment, the excess real balances are spent on foreign goods and services. This causes the exchange rate to depreciate. On the other hand the increase in money supply puts pressure on domestic prices which causes the money demand to rise and contracts aggregate demand till PPP is restored at a higher price level. The net effect of an X percent increase in money supply is an X percent increase in price level and X percent depreciation of exchange rate.

*Increase in income*

Under monetary approach an increase in real income affects BOP by influencing money demand. The mechanism under the two alternate regimes is outlined below.

*Increase in income – Fixed exchange rate regime*

Increase in real income increases the demand for transaction balances. Thus money demand exceeds money supply. This leads to relatively reduced expenditure (relative to income) on both domestic and foreign goods. The reduced expenditure pulls down the price level. This makes the domestic goods more competitive. Exports rise, imports fall, BOP improves and the currency tends to appreciate. To prevent appreciation the authority purchases foreign currency against newly created money base. Increase in money supply restores the money market equilibrium (which was disturbed with increase in money demand due to increase in real income). Higher, money supply causes the

aggregate demand to rise. Given full employment, price level rises to restore the PPP. Thus the competitive advantage, gained due to increase in real income is eliminated.
It's worth noting that in the equilibrium restoration process money supply has increased. This has been possible because at higher level of real income people willingly hold more transaction balances.

*Increase in income – Floating exchange rate regime*

As explained earlier, with the increase in real income money demand goes up and the price level falls. With the fall in price level the exchange rate appreciates to maintain PPP. In the long run there is an increase in real money balances due to willingness to hold more at higher level of income and exchange rate has appreciated.

*Change in foreign price level – Fixed Exchange rate regime*

Increase in foreign price level makes domestic goods more competitive. Exports rise, BOP improves and the exchange rate tends to appreciate. To prevent appreciation the authority intervenes by purchasing foreign currency against newly created money base. The expansion in domestic money supply, given full employment, puts pressure on domestic prices, till the price level rises enough to restore PPP. In sum, under fixed exchange rate, an increase in foreign price level causes a corresponding increase in domestic price level. Thus under the regime, a country cannot avoid imported inflation.

*Change in Foreign price level – Floating exchange rate regime*

Increase in foreign prices makes the domestic goods more competitive. Demand for domestic currency rises causing the exchange rate to appreciate. This offsets the competitive advantage. The domestic price level, aggregate demand and output remain unaffected. The ability of the authority to insulate the domestic economy from the consequences of increase in foreign price level allows it to follow monetary policy of it's own choice: the one in line with its growth and inflation targets. This is the biggest argument in favour of the floating regime.

### 2.1.4 General Evaluation of Monetary Approach

Monetary approach highlighted the role of money in the adjustment process (i.e. equilibrium restoration) at a time when the common tendency was to ignore money and

concentrate exclusively on real variables. Besides the monetary approach can be used to bring out the inconsistencies in income/absorption approach (see Kuska, 1978). However the monetary approach may have gone too far in emphasizing the role of monetary variables to the virtual exclusion of everything else (Kreinin & Officer, 1978)

Monetarists argue that devaluation is useless because the competitive advantage gained due to devaluation is lost with the passage of time. However it's worth noting that devaluation is taken from position of deficit, involving an excess supply of money. Devaluation can quickly mop up the excess money supply rather than economy putting-up with the lengthy-wait for the self-correction to materialize. The faster the excess supply is eliminated the better it is for economy.

*Adjustment cost*

Monetarists argue that since deficits are self-correcting therefore these present no problem. Cordon (1977. p. 45) points that, all economic agents including governments make mistakes in the adjustment process (and mistakes have a cost). Krenin & Officer (1978) state that the problem is the cost of adjustment and the policy issue is how to minimize the cost. Intervention in foreign exchange market cuts short the adjustment process and thus minimizes adjustment cost. Hence policy intervention is not entirely irrelevant as implied by monetary approach.

*Validity of Assumptions?*

Monetary approach assumes, a stable money demand function, full employment and that PPP holds. Boughton (1988) has argued that nearly every assumption of monetary approach is open to debate. He states that there is ample evidence that money demand function is unstable, economies are rarely at full employment level and PPP is a useless guide to exchange rate movements. These assumptions hold reasonably well in long run but are rarely fulfilled in short run. The empirical invalidity of key assumptions puts to question the policy relevance of monetary approach.

It is suggested that monetary approach provide an insight into short run disequilibrium of BOP. Pilbeam (1998) argues that it's not proper to use assumptions that are valid only in long run to explain happenings in the short run. Pilbeam goes on to suggest that postulates of monetary approach about long run consequences of changes in

economic policy are probably more insightful than its postulates about short run consequences.

Monetary approach posits that under fixed exchange rate regime any increase in domestic money supply is offset by an equivalent fall in foreign reserves. In practice this may not be true if there exists unemployment (which is quiet often the case). In that case an expansionary monetary policy may lead to increase in output which by increasing money demand will reduce the devaluation pressure. Given this situation the reserves need not fall by the exact amount of increase in domestic money supply, as some of the increase shall be willingly held as transaction balance due to increased output.

*Composition of Deficit/Surplus*

Under monetary approach if a large deficit in current account is offset by equivalent surplus in capital account there is no cause of policy concern, because deficit and surplus are essentially considered as self-correcting. Such an approach ignores the dangers of increasing foreign/international indebtedness. Recent history of developing countries is evidence that international indebtedness comes with such strings, which not only compromise the economic independence of the country concerned but compromise the very sovereignty of a nation in almost every walk of life. Besides, the third world debt crisis of the eighties and East Asian crisis of 97/98 speaks volumes about economic perils of huge foreign indebtedness.

### 2.1.5 Empirical Evidence

Much of the empirical evidence on monetary approach attempts to measure the 'off-set coefficient'. This measure the extent to which an increase in domestic component of monetary base leads to a fall in reserves of like amount in a fixed exchange rate regime as postulated by the monetary approach. To validate the monetary model empirical estimate of the offset coefficient requires that it be equal to –1. Some of the better known estimates, covering various countries and periods of fixed exchange rate system that prevailed prior to 1973 are presented in the following table.

Table: 2.1
Monetary Approach to BOP
Empirical Evidence: Offset Coefficient

| **Study** | **Country** | **Estimation Period** | **Offset Coefficient** |
|---|---|---|---|
| Bean (1976) | Japan | 1959-70 | -0.67<br>(-8.32) |
| Genberg (1976) | Sweden | 1959-70 | -1.11*<br>(-3.00) |
| Kouri & Porter (1974) | Australia | 1961-72 | -0.47<br>(-5.29) |
| | Germany | 1960-70 | -0.77<br>(-18.40) |
| | Italy | 1964-70 | -0.43<br>-(4.36) |
| | Netherlands | 1960-70 | -0.59<br>(-7.58) |
| Obstfeld (1982) | Germany | 1961-67 | 0.003<br>(0.001) |
| Taylor (1990) | UK | 1965-71 | -0.49<br>(-5.44) |

Notes: The hypothesis is that offset coefficient is equal to –1.
An asterisk by the reported estimate indicates that it is statistically in line with the hypothesis.
The t-statistics are reported in parentheses.

As evident from the table 2.1 empirical evidence on the monetary approach is somewhat mixed. In Bean (1976) and Kouri & Porter (1974) the offset coefficient is of the correct sign but it is statistically different from –1. One explanation that may help to explain the lower than expected offset coefficient was put forward by Magee (1976) who pointed out that exchange rates were not rigidly fixed under the Bretton Woods system. This being the case, part of an increase in the domestic component of monetary base may be absorbed by a depreciation of exchange rate rather than fall in reserves.

Obstfeld (1982) observes that estimate of Kouri & Porter (1974) and Bean (1976) were likely to have been overestimates of offset coefficient because of the frequent practice of sterilization of foreign exchange intervention by central banks. Suppose a country expands the domestic component of monetary base: there would be pressure for the currency to depreciate and authorities will have to buy domestic currency leading to fall in their foreign reserves. To prevent, fall in money supply

authorities typically tend to sterilize the fall by further purchases of domestic bonds. To the extent that purchasing bonds does not induce further outflow of reserves, the offset coefficient will be greater than –1, i.e. to the extent that the expansion in domestic component of monetary base is greater than the fall in reserves. In his study, Obstfeld (1982) finds that that the offset coefficient for Germany changes from –0.55 to an insignificant 0.003 when sterilization practices have been accounted for. Obstfeld result therefore casts grave doubt on the validity of monetary approach. Pilbeam (1998) states that all the evidence on MABOP needs to be treated with caution as all the studies assume that price level, real output and interest rates are exogenous and unaffected by changes in money supply. Such assumptions have no basis in economic theory and are unlikely to be fulfilled in real world.

## 2.2 **Monetary Approach to Exchange Rate**

The monetary approach views currencies as assets and exchange rates as price of one asset in terms of another asset. As demand/supply of an asset undergoes change its price changes accordingly. The monetary approach, in essence, holds that only monetary factors play a role in determination of exchange rate. We describe below three important models exchange rate determination under the monetary approach. Two common characteristics of these models are: First, supply and demand for money are the key determinants of exchange rate and second, all three models employ uncovered interest parity (UIP) i.e. they assume that domestic and foreign bonds are equally risky so that their returns are equalized.

### 2.2.1 Flexible Price Model

This model developed by Frenkel (1976), Mussa (1976) and Bilson (1978a) assumes that PPP holds continuously but still it represents a valuable addition to exchange rate theory in that it explicitly introduces the role of relative money stock in determination of relative prices that in turn determine the exchange rate.

The model starts by assuming that there is a conventional money demand function given by:

$$m - p = \eta y - \delta r \qquad (2.5)$$

Where L.H.S. represent real money demand and on R.H.S. $y$ and $r$ represent domestic real income and domestic interest rate.

Similar money demand function holds for foreign money demand

$$m^* - p^* = \eta y^* - \delta r^* \quad (2.6)$$

where * denotes, foreign origin of the variables.

Rearranging (2.5) and (2.6) gives us solution for domestic and foreign pieces

$$p = m - \eta y + \delta r \quad (2.7)$$

$$p^* = m^* - \eta y^* + \delta r^* \quad (2.8)$$

Now assume that PPP holds so that:

$$s = p - p^* \quad (2.9)$$

Where $s$ represents nominal exchange rate

Substituting (2.7) and (2.8) in (2.9) gives us the exchange rate equation

$$s = (m - m^*) - \eta(y - y^*) + \delta(r - r^*) \quad (2.10)$$

Equation (2.10) states that the exchange rate between countries is determined by relative level of, money supplies, national income and interest rates. Discussion of the determinants follows.

*Relative Money supplies*

A given percentage increase in domestic money supply leads to a corresponding depreciation of domestic currency. The rationale is that increase in domestic money supply causes increase in domestic prices and for PPP to hold the exchange rate must depreciate.

*Relative Level of National Incomes*

Increase in domestic income causes the currency to appreciate and vice versa. The rationale is that increase in income increase domestic demand for money. With money supply and interest rate held constant; the only way higher demand for real money balances can be satisfied is through decrease in prices. Now, domestic prices having fallen, for PPP to hold the exchange rate must appreciate.

*Relative interest rates*

An increase in domestic interest rate leads to depreciation of the currency. The reason is that as the interest rate increase the demand for money decreases. With supply held constant, the increased money demand can only be met with higher domestic prices. As domestic prices increase, for PPP to hold the currency must depreciate.

The flexible price monetary model assumes that all prices in economy are fully flexible, that bonds are perfect substitute (i.e. uncovered interest parity holds) and what matters for exchange rate determination is the demand for money in relation to its supply.

Despite its shortcomings, like assuming perfect capital mobility and reliance on PPP, the model represents an important addition to exchange rate theory in that it introduces the role of relative money supplies, inflationary expectations and economic growth as determinants of exchange rate.

**2.2.2 Dornbusch sticky price model**:

One of the major shortcoming of the Flexible-price model is that it assumes that PPP holds continuously and that goods prices are flexible, upwards as well as downwards. As such the model is not of much use in explaining the observed prolonged departures of nominal exchange rate from PPP.

The Dornbusch model assumes that PPP holds only in the long run and that UIP hold continuously. The model introduces the concept of exchange rate overshooting. The basic import of the model is that Exchange rate is determined in a perfectly flexible environment. While prices in the goods market and wages in the labour market are determined in a sticky environment (especially prices and wages are sticky downwards) In such circumstances exchange rate changes are not matched by corresponding changes in prices leading to prolonged departures from PPP.

To understand the mechanics, assume that the authorities increase money supply by 10 percent when the economy is in equilibrium. Now, given the increase in money supply prices will also increase by 10 percent in the long run. But given that prices are sticky in short run and the economy is at full employment level, the increase in money supply causes excess supply. The excess supply is willingly held only if the interest rate declines. The decline in interest rate calls for an appreciation of exchange rate to

compensate the speculators for loss on account of lower interest rate. Given this, the depreciating exchange rate (due to increase in money supply) must overshoot its equilibrium value to allow for the subsequent appreciation, required for compensating the speculators.

*Importance of sticky-price model*

Major innovation of the model is its emphasis on capital market rather goods market arbitrage being the determinant of exchange rate in the short run. Goods market arbitrage is viewed as relevant to exchange rate determination only in medium to long run, while the desire of the investor to equalize expected yield on their international portfolios is viewed as major determinant of exchange rate in short run. Secondly the model provides an explanation of why exchange rate changes have been large relative to international price movements and changes in international money stock.

### 2.2.3 **Frankel's Real Interest Rate Differential model**

The sticky-price monetary model of Dornbusch represented a major advance on the flexible-price monetary model of exchange rate but unlike the former it did not explicitly model the role of inflationary expectations as determinant of exchange rate. Frankel (1979) developed a general monetary exchange rate model that accommodates flexible-price and sticky-price monetarists model as special cases.

The reduced form equation of the Frankel's model is given by:

$$s = (m - m^*) - \eta(y - y^*) + \sigma(P\dot{e} - P\dot{e}^*) - \frac{1}{\theta}[(r - P\dot{e}) - (r^* - P\dot{e}^*)] \qquad (2.11)$$

Where $s$ is Nominal exchange rate, ($m$-$m^*$) is Relative money supply , $(P\dot{e} - P\dot{e}^*)$ is inflation differential, $(r - P\dot{e})$ is domestic real interest rate and $[(r - P\dot{e}) - (r^* - P\dot{e}^*)]$ is real interest rate differential. Besides an * on variables denotes their foreign origin.

Frankel's model, given by (2.11), states that if there is a disequilibrium set of real interest rates, then the real exchange rate of domestic currency will deviate from its

equilibrium value. This induces an expected appreciation of the real exchange rate of domestic currency to compensate for the loss on account of real interest rate differential. The fully flexible-price model assumes that all markets clear instantaneously so that the speed of adjustment; $\theta$ in equation (2.11) is infinite. Given that $\theta$ is infinite, the term $[(r - P\dot{e}) - (r* - P\dot{e}*)]$ in equation (2.11) becomes zero so that the flexible-price model holds. In real interest rate model as given by equation (2.11), goods and labour market are assumed to be slow to adjust to shocks so that the adjustment parameter; $\theta$ is finite. Thus the rational expectations hold for foreign exchange market but not for goods and labour market. In such circumstances, an unanticipated increase in money supply causes the real domestic interest rate to fall relative to foreign interest rate. The result according to equation (2.11) is that the short run exchange rate overshoots its equilibrium value; depreciating proportionately more than the increase in money stock so that there are expectations of future real appreciation of the currency to compensate for the lower real rate of return on domestic bonds.

### 2.2.4 Conclusion: Monetary models

All monetary models are build upon PPP. The flexible-price monetary model assumes that PPP holds continuously and maintains that price level changes to adjust instantaneously to changes in supply and demand for money. This then leads to immediate exchange rate adjustment to maintain PPP. Under the model, changes in real income and inflationary expectations induce changes in exchange rate through their influence upon money demand. In sticky-price monetary models, the asymmetric speeds of adjustment in goods and money market can lead to divergence from PPP in short run; though it holds in long run.

The sticky-price monetary models provide both an explanation of exchange rate misalignment as well as exchange rate volatility. Exchange rate can become misaligned in relation to PPP because of the phenomenon of overshooting, while instability in monetary polices can cause even greater instability in exchange rate. An important point made by sticky-price models is that divergence from PPP as well as highly volatile exchange rates can be explained by rational speculation and are not essentially the result of irrational foreign exchange speculation.

An noteworthy limitation of the monetary model is omission of the current account in determination of exchange rate. Besides domestic and foreign bonds are regarded as perfect substitute i.e. they are equally risky. Thus there is no role for risk perception to play in the determination of exchange rate.

## 2.3 Purchasing Power Parity

Purchasing Power Parity (PPP) hypothesis postulates a relationship between exchange rate and prices. Though some economists trace back PPP hypothesis more than two centuries back (e.g. Humphery & Keleher, 1982)[3], it is without doubt the work of Cassel (1916)[4] which attracted modern interest in the PPP hypothesis. Three versions of PPP have traditionally been used in literature: the law of one price that relates exchange rates to prices of individual homogenous goods in different countries; absolute PPP, that relates exchange rates to overall price levels and relative PPP, that relates exchange rate changes to inflation rates.

### 2.3.1 Law of one price

The law of one price holds that, in the absence of transaction costs or trade barriers (such as tariffs & quotas), the prices of identical goods sold in different countries should be the same, when expressed in a common currency. Empirically, the law of one appears to hold well for homogenous primary commodities traded on major (commodity) exchanges, when adjustments are made for contract differences and delivery lags.

### 2.3.2 Absolute PPP

Absolute PPP extends the law of one price to the general price level. It predicts that the same basket of goods and services should cost the same in all countries. If the law of one price holds for every good than the absolute PPP should also hold. Absolute PPP however requires parity relationship to hold on an average, rather than for each good.

Absolute PPP provides a specific equilibrium exchange rate, namely, PPP exchange rate. This is defined as the rate that equalizes the prices of a common basket of

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[4] Cited in Moosa & Bhatti (1997), p.25

[4] Cited in Moosa & Bhatti (1997), p.25

goods in two different countries. Deviations between the market exchange rate and the PPP exchange rate are viewed as short-lived, as these would be eliminated by arbitrageurs purchasing goods in one country and selling the same in another. Algebraically, absolute PPP is given by:

$$S = P/P^* \qquad (2.12)$$

Where S is nominal exchange rate, P is domestic price level and P* is foreign price level. Testable form for absolute PPP is:

$$\ln s_t = a_1 + a_2 (\ln p_t - \ln p_t^*) \qquad (2.13)$$

For absolute PPP to hold the regression estimate would yield $a_1 = 0$ and $a_2 = 1$

Despite their intuitive appeal, the empirical usefulness of the law of one price is limited. Transportation/information costs and institutional impediments to trade, such as tariffs and quotas, may limit consumers' and firms' responses to cross-country price differences, thus preventing absolute price levels from being equalized internationally.

### 2.3.3 Relative PPP

Relative PPP is a weaker condition than absolute PPP. It predicts only that changes in nominal exchange rate should equal the difference between domestic and foreign inflation on equivalent basket of goods. If PPP is judged to hold in some particular year, one can obtain from a time series of inflation differential, the implied PPP nominal exchange rate, which can then be compared with the market exchange rate. Algebraically relative PPP is given by

$$\%\Delta S = \%\Delta P - \%\Delta P^* \qquad (2.14)$$

Where P & P* are domestic and foreign price indices respectively.

Testable form of relative PPP is:

$$\Delta \ln s_t = a_1 + a_2 (\Delta \ln p_t - \Delta \ln p_t^*) \qquad (2.15)$$

For relative PPP to hold, regression estimate would yield $a_1 = 0$ & $a_2 = 1$

### 2.3.4 PPP: Revival of Interest

A major factor causing the revival of interest in PPP is the development of open economy macroeconomics. First, PPP is an essential element of monetary models of exchange rate determination to the extent that empirical failure of monetary models has been attributed to the invalidity of PPP (Lane, 1991). Flexible price models developed interalia by Frenkel (1976), Mussa (1976) & Bilson (1978) assume that PPP holds

continuously. In Dornbusch's (1976) sticky price model PPP is assumed to hold only in long run. In Frenkel's (1979) real interest rate differential model the long run equilibrium exchange rate, is derived by combining PPP with monetary equilibrium of the two countries. Overall PPP is an essential condition for solution of these models. Besides PPP is an important component of theoretical models of Balance Of payments (e.g. Dornbusch 1982). Finally PPP (like other international parity condition) seems to have critical implication for some aspects of international finance such as capital flows, financing & investment decision and market efficiency.

PPP may be viewed as an equilibrium condition rather than a complete theory of exchange rate. However PPP is viewed as complete theory of world inflation. PPP Under fixed exchange rate, implies that inflation rates, subject to certain reservations, should be equal across countries of an integrated world economy. In this case adjustment to the PPP takes place via adjustment in domestic prices. On the other hand, under floating exchange rate adjustment to PPP occurs via adjustment in nominal exchange rate as well as domestic prices.

### 2.3.5 PPP: Monetary view

This view holds that if the source of disturbance is of pure monetary nature (real factors remain unchanged) than the exchange rate adjusts to offset the impact of monetary disturbance (excess of domestic inflation over foreign inflation). The monetary view predicts that following monetary growth, exchange rate will increase (depreciate) as much as the increase in price. The main force in operation here is the causal chain running from monetary disturbance to prices to exchange rate. This is because PPP is viewed as an extension of quantity theory of money to the case of open economy. This in turn is due to the extension of concept of neutrality of money to an open economy. Neutrality of money in the context of PPP implies that monetary factors determine the nominal exchange rate via their effect on prices leaving the real exchange rate unchanged.

### 2.3.6 Empirical evidence

*Long run data*

Results of empirical tests of PPP are sensitive to data frequency (monthly, quarterly or annual), time horizon (e.g. last twenty years or hundred years) and sample size (small vs. large). Cointegration test normally requires large sample because firstly, small sample bias can be substantial and secondly, super consistency property of the OLS estimators of the cointegrating parameters hold only asymptotically.

Ideally PPP should be tested for low frequency data stretching over a long period sufficient enough to allow the stationary component to iron out the random walk component. Ardeni & Lubian (1991) have noted that a sample of monthly observations covering three years will not single out mean reversion if it is detectable in a range between ten to twenty years. This is because such a sample contains only three independent observations.

Frankel (1986) finds evidence, lending support to PPP between US and UK by increasing the sample. However, the study uses high frequency data over short time horizon. Given the argument of Ardeni and Lubian referred above, this practice is questionable.

*Tests based on cointegration*

Empirical tests of PPP based on cointegration reveal mixed evidence. Moosa and Bhatti (1995, p.221) cites numerous studies for and against the validity of PPP hypothesis. They conclude that studies employing the most sophisticated techniques have documented more evidence in favour of PPP than those using conventional techniques. In general, studies based on Johansen technique have produced more favourable results than those based Engle-Granger.

Moosa & Bhatti (1997, p. 236), argue that most studies investigating the validity of PPP over the flexible exchange rate period have used data on industrial countries. These countries have experienced relatively low inflation. One of the factors which is thought to have caused deviation from PPP among these countries is the occurrence of real shocks which altered the inter sectoral price structure (Balassa, 1964). However PPP is likely to hold better for countries experiencing very high inflation rates because monetary growth would presumably overshadow real factors. In line with this argument

Mc Nown & Wallace (1989) tested PPP for four high inflation countries and found evidence supportive of PPP in three cases *viz*., Chile, Argentina & Israel. Bhatti (1996) investigates the long run PPP for Pakistan and its eight industrialized trading partners. The results are supportive of PPP, however the study by Ahmad and Khan (2002) which examines the PPP proposition for six selected Asian countries including Pakistan find that, on the whole, PPP does not hold even in its weak form, however the results in respect of Pakistan are relatively more supportive of PPP but these do not validate the PPP.

The GR model in spirit is based on the assumptions that (i) inflation is a purely monetary phenomenon and (ii) Purchasing power parity (PPP) holds. The validity of these assumptions is discussed below:

The empirical evidence on validity of PPP is mixed. According to Bartolini (1995) two things clearly come out of the evidence:

- PPP holds reasonably well over the long run for industrial countries but it does not explain well the short run behaviour of exchange rate in these countries.

- When exchange rate and price movements are compared between developed and developing countries-either the long run or the short run PPP is clearly rejected as large differences between inflation differential and bilateral exchange rate persists in many cases.

**2.3.7 Deviations from PPP**

Nominal exchange rate may deviate from its PPP value due to productivity differentials between countries (Balassa, 1964), transport and trade impediments, imperfect competition and menu costs, and the different adjustment speeds of goods prices and the exchange rate may cause the exchange rate to deviate from its PPP value[5].

**2.4 Inflation: A monetary phenomenon?**

Milton Freidman (1963) states that "inflation is always and everywhere a monetary phenomenon". Friedman's statement is based on quantity theory of money given by the equation:

$$MV = PY \qquad (2.16)$$

Where M is the money supply, V is the velocity of money (i.e. the rate of turnover of money in the economy), P is the general price level, and Y is real income. Transforming each variable into growth form and rearranging the terms gives us the following equation:

$$\dot{P} = \dot{M} + \dot{V} - \dot{Y} \qquad (2.17)$$

Equation (2.17) states that growth in prices is determined by growth in money supply, velocity of money and real income. A simple version of quantity theory assumes that velocity of money is constant and that real income grows at a constant long run rate. Under these assumptions the quantity theory states that inflation is proportional to growth in money supply.

It has been argued that developing economies with rapidly growing manufacturing sector when encountered with supply rigidities, especially from agriculture sector, can produce rapid increase in prices in the absence of corresponding increase in agricultural products. Such sectoral increase in prices may lead to increase in the overall price level.

The empirical evidence on explaining inflation in Pakistan, on balance, accords a primary role to money as determinant of inflation but warns that supply side factors also play an important role in explaining inflation in Pakistan, while the administered prices of certain items are also assigned some role. The studies that clearly validate the monetarist hypothesis for Pakistan include, Khan and Schimmelpfennig (2006), Qayyum (2006), Kemal (2006), and Hossain (1990) while the studies that find money to be an important determinant of inflation but note that supply side factors have also contributed to inflation in Pakistan include, Naqvi *et al*. (1994), Khan and Qasim (1996) and Bilquees (1988). Pasha *et al*.(1995) find that procurement prices, especially that of wheat and administered prices of fuel, gas and electricity have been the key determinant of inflation in Pakistan.

[5] For discussion on the causes of deviation from PPP exchange rate see Pilbeam (1999).

The authors do not find a significant role of demand management policies or supply shocks in explaining inflation in Pakistan.

One reason for the conflicting findings of different studies could be that these are for different periods. Given the evidence, to conclude the debate on monetarist versus structuralist hypothesis, (or supply shocks) we would like concur with, Bilquees (1988) that superiority of one hypothesis over the other cannot be established.

The readers, while looking at our results, need to bear this caveat in mind that the assumption that 'inflation is a purely monetary phenomenon' may not fully hold however it is difficult to reject the assumption altogether.

## Literature Review-II

# 3 Exchange Market Pressure

Girton and Roper (1977) developed a model to explain both the exchange rate movement and foreign reserves movement and referred to the composite dependent variable *(r + e )* as the exchange market pressure, where *r* represents the change in foreign reserves scaled by monetary base (reserve money) and *e* represents the percentage change in exchange rate over the period under consideration.

### 3.1 Girton and Roper's *emp* Model

The main theoretical proposition of the Girton and Roper (henceforth GR) model is that the domestic money market equilibrium if disturbed is restored through some combination of the currency depreciation/appreciation and foreign reserves outflow/inflow. The excess in domestic money supply over domestic money demand will cause a combination of currency depreciation and reserves outflow while excess in domestic money demand over supply will cause some combination of currency appreciation and reserves inflow to restore the money market equilibrium.

The model developed by GR is a monetary model in the sense that it organizes the analysis around the demand and supply of national monies. As the model allows changes in foreign reserves as well as variations in exchange rate, therefore it is hybrid of monetary approach to BOP and monetary approach to exchange rates. GR derive their measure of exchange market pressure (*emp*) in a monetary framework with two large interdependent economies and use it to quantify the volume of central bank intervention required to achieve any desired exchange rate target. GR's measure of exchange market pressure is the simple sum of percentage change in exchange rate and variation in foreign reserves (scaled by monetary base) of the central bank. The change in reserves is scaled by monetary base to obtain a real measure of the change. GR convert the nominal measure (expressed in domestic currency) of the change in reserves into real terms to make the changes comparable overtime.

The measure is used as the dependent variable in investigating the extent to which monetary policy can be independently formulated in open economies.

GR derive the exchange market pressure monetary model, using the monetary equilibrium condition, expressed as:

$$H_i = F_i + D_i = P_i \; Y_i^{\beta} \exp(-\alpha i) \qquad (3.1)$$

Where $H_i$ = Supply of base money issued by central bank
$F_I$ = base money created against the purchase of foreign assets
$D_i$ = base money created against domestic credit expansion
$P_i$ = Price level
$Y_i$ = Real Income

By subtracting the foreign monetary equilibrium condition from domestic monetary equilibrium condition and doing the necessary manipulation GR obtain the following model.

$$r_c + e_c = emp_t = -\acute{o}_c d_c + \acute{o}_u h_u + \beta_c y_c - \beta_u y_u + v \qquad (3.2)$$

Where r = change in reserves scaled by base money
e = percentage change in exchange rate
$emp_t$ = exchange market pressure
d = change in domestic credit scaled by base money
y = percentage change in real income
$h_u$ = change in US (foreign) money supply
$\acute{o}$ = coefficient of domestic credit
c = subscript for Canadian (domestic )variables
u = subscript for US (foreign) variables

The assumptions, explicit and implicit, in GR model are:

- Stable demand for money function (money multiplier is held constant)
- PPP holds.
- Flow equilibrium in money market.
- Indirect intervention is ruled out.
- Domestic and foreign, interest rates are assumed to grow at equal rate, that is interest rate differential is held constant.

GR's model differs from other monetary models of Balance of Payments (BOP) in three respects. First, the dependent variable is exchange market pressure, defined as the sum $r + e$, rather than the BOP, Second the model takes into account the fact that a country's monetary policy can be judged as tight or loose only by reference to what is happening in rest of the world. Third GR's model holds for all exchange rate regimes.

(Of the dependent variable $r + e$, $r$ and $e$ are respectively zero, under floating and fixed exchange regimes, rest of the model remains unchanged).

The purpose of GR's paper is threefold:

a) To estimate the exchange market pressure model, that is to investigate as to what explains exchange market pressure.
b) To determine the degree of monetary independence enjoyed by the economy under investigation.
c) To determine whether the magnitude of exchange market pressure is sensitive to its composition between exchange rate changes $e$ and reserves changes $r$ (i.e. is there is a one to one trade-off between $e$ and $r$).

To determine the degree of monetary independence, GR uses the coefficient of domestic credit to draw inference about monetary independence. Higher coefficient implies lower degree of monetary autonomy. It may be mentioned that if the major part of change in domestic credit is offset by change in foreign reserves, then degree of monetary autonomy is low. On the other hand if the economy absorbs the impact of change in domestic credit by letting the exchange rate adjust then the degree of monetary autonomy is high.

The coefficient of domestic credit, will only tell us as to what extent the composite variable $r + e$ would change in response to certain change in domestic credit. However the coefficient will not reveal the composition of change between exchange rate and foreign reserves. But precisely, it is the composition of change which is required, to judge the degree of monetary autonomy. Therefore the coefficient of domestic credit does not tell much about the degree of monetary autonomy unless the change in either the exchange rate or domestic credit is zero. GR's followers have addressed this shortcoming.

GR (1977), propose to include an additional variable Q=(e/r) in the *emp* model given by equation (3.2), to see whether the monetary authority absorbs exchange market pressure either by the exchange rate depreciation or foreign reserves depletion. A significant and positive coefficient of Q implies that the monetary authority absorbs more

pressure by exchange rate depreciation, while a significant and negative Q implies that more pressure is absorbed by reserves losses. An insignificant coefficient implies that the monetary authority is not sensitive to components of *emp*. The coefficient of Q is important in the sense that it allows us to see whether a country follows a traditional monetary approach to balance of payments or exchange rate determination model or GR's *emp* model, where they use the sum of the growth rate of nominal exchange rate and the growth rate of the international reserves as an, *emp* variable.

**3.2 Evolution of Exchange Market Pressure Model**

Cannolly and Silveira (1979) applied the GR model to Brazil for the period 1955-75. Deviating from GR model, Connolly and Silveira (CS) takes the world prices and monetary conditions faced by Brazil as given. This according to CS suits the purpose of most monetary models that make this assumption and obviates the problem of monetary dependence and neutralization dealt with in the pioneering GR paper.

CS derive a simple one country equation of managed floating which depends upon four essential ingredients 1) money demand 2) money supply 3) Purchasing power parity and 4) monetary equilibrium. Final equation of CS exchange market pressure model is:

$$r + e = emp = - d + p^* + y \qquad (3.3)$$

Where $r$ is the change in foreign reserves as a proportion of money supply, $e$ is the percentage change in exchange rate, $d$ is the change in domestic credit as percentage of money stock, $p^*$ is the world rate of inflation and $y$ is the rate of growth of permanent income.

Equation (3.3) states that growth of domestic credit, for given rate of growth of world prices and permanent income, will result in proportionate loss in reserves with no change in exchange rate or proportionate depreciation of exchange rate or some combination of the two.

CS improve upon GR by using Q = (e-1)/(r-1) rather than Q = e / r. To make a case for revising GR's variable Q, CS rightly argue that the simple e/r ratio used by GR, does not have the desirable monotonic property, since it is discontinuous for values of *r*

equal to zero. This, according to CS is empirically important for countries where, over the sample period, surplus turns into deficits and vice versa frequently.

Paradhan *et al*. (1989) applies CS version of the GR's exchange market pressure model to India. They have noted two limitations of the model. First, the model assumes absence of sterilization activities by central bank. Sterilization refers to the ability of the central bank to reduce (increase) the domestic component of money demand when there is excess demand (supply of) for foreign reserves. In, presence of sterilization central bank may be able to neutralize or sterilize any foreign reserves outflow (inflow) induced by monetary policy to achieve the desired monetary goal. Second, growth rate of foreign money supply, particularly of the major trading partners, should be considered but is excluded from the model. Sheehan (1987) has shown that the growth rate of U.S. money supply affects the growth rate of other international currencies. It's worth recalling here that foreign money supply variable is included in the original model developed by GR. CS, by making 'small open economy' assumption, takes the foreign monetary conditions as given. Hence foreign money supply variable is not included in their model. Paradhan *et al*. who have noted the limitation regarding absence of foreign money supply growth, variable from the model have used the CS version. Besides Paradhan *et al*., others who have used the CS version include, Modeste (1981) Kim (1985) and Thornton (1995).

Wohar and Lee (1992) applies an expanded version of the GR model to the Japanese experience using annual data for the period 1959-86. Wohar and Lee (WL hereafter) developed and estimated a less restrictive and more expanded versions of the models estimated by GR (1977) for Canada, CS (1979) for Brazil, Modeste (1981) for Argentina and Kim (1985) for Korea – models that imposed condition of purchasing power parity and equal growth rates for inter-country interest rates. WL's unrestricted model allows for deviation from purchasing power parity and for domestic and foreign interest rates to grow at different rates. Besides he does not assume constant money multiplier. Lee's estimation indicates that his unrestricted model performs significantly better than the restricted model used in all previous works. WL's basic model to be estimated is:

$$r\text{-}e = emp = -a - c + m^{*} + n_1 y - n_2 y^{*} + \theta - sd \qquad (3.4)$$

Where $r$ is the change in foreign reserves scaled by base money, $e$[6] is percentage change in exchange rate, $a$ is growth rate of money multiplier, $c$ is growth rate of domestic credit scaled by base money, $m^*$ is the growth rate of foreign money supply, y is the growth rate of permanent income with $y^*$ being the corresponding foreign variable, $\theta$ is the differential of domestic inflation rate from purchasing power parity condition and $d$ is the interest rate differential.

The coefficients are hypothesized as follows.

$a = -1, c = -1, m^* = 1, y = 1, y^* = -1$ and $d < 0$

WL derived the model in a manner similar to GR i.e. by subtracting the foreign monetary equilibrium condition from domestic monetary equilibrium condition. A look at, WL's unrestricted, model shows that he takes care of one of the limitation of exchange market pressure model (CS version), noted by Paradhan et al., the one regarding the absence of foreign money supply variable from the model.

WL developed an alternate model specification as well, that differs from the GR model with regard to transmission of foreign disturbance including inflation in particular and macroeconomic policy in general. The GR model specifies that foreign disturbances are transmitted to exchange market pressure through growth of foreign money supply, controlling for real income growth. WL's alternate model, instead, specifies that unequal growth in domestic and foreign inflation rates (inflation differential) and unequal growth in domestic and foreign interest rate (interest rate differential), are the primary source of transmission of foreign disturbances to exchange market pressure. WL employs Davidson Mackinnon test to choose between GR model and his own model. The test finds WL's Model superior to GR's model.

Till the study by Thornton (1995) the exchange market pressure model was mainly used to test the monetary approach. Except for GR, others do not make a direct reference to monetary autonomy. Besides the model also served to figure out, whether or not the model could be used to determine the magnitude of intervention required, to achieve a target exchange rate. Beyond this neither an attempt was made, to find out the

[6] Wohar and Lee (1992) define $e$ as the change in exchange rate therefore to signify exchange rate depreciation as component of exchange market pressure, they introduce a minus sign with $e$ in equation 2.4.

instruments of monetary policy used to manage exchange market pressure nor an analysis of causal relationship between exchange market pressure (*emp*) and monetary policy instruments was ever undertaken. The reason for the former is that except for WL's model, the model used by other authors' includes only one monetary instrument i.e. domestic credit so the question of choice between monetary instruments does not arise. The reason for the latter could be that, single equation, models used by the authors do not permit the study of feedback relationship. With advancement in econometrics more sophisticated techniques like vector autoregression became available. VAR framework permits the study of feedback relationship from dependent to independent variables. Another shortcoming of the empirical literature discussed so far had been the absence of a specific test to measure the degree of monetary autonomy. Tanner (2001, 2002), Kamaly & Erbil (2000) and Bautista and Bautista (2005) uses VAR framework to test the exchange market pressure model. These papers address the shortcomings mentioned above.

Tanner (2001) uses exchange market pressure model (GR in spirit) to study the relationship between exchange market pressure (*emp*) and monetary policy, in more detail. Specifically the paper examines three issues: First, does the monetary policy effect *emp* in the way that standard framework predicts i.e. for example, does contractionary monetary policy reduces *emp*. Second, how should the stance of monetary policy be measured i.e. by using domestic credit or interest rate. Third, in what sense is the stance of monetary policy itself a function of *emp* i.e. is there any feedback relation from monetary policy to *emp.* Thus rather than merely focusing on validation of the monetary approach, Tanner uses *emp* model to examine as to what monetary tools (domestic credit or interest rate) do the authorities use, when faced with *emp* (during normal periods as well as currency crises periods). Besides he analyses the nature of relationship between the dependent and explanatory variables i.e. whether the causality is one way or both-ways. Analysis of this kind could of course be of great help to the framers and executors of monetary policy.

To address the aforementioned issues, Tanner uses a Vector autoregression framework, whose variable include exchange market pressure, domestic credit and

interest rate differential (between domestic and foreign rate). Algebraically, the framework is:

$$X_t = a_o + ax_{t-1} + ax_{t-2} + ..... + v_t \qquad x = (\delta, emp, \Delta\phi) \qquad (3.5)$$

Where δ = domestic credit and Δϕ = change in interest rate differential.

Impulse response functions (IRF's) generated, using Choleski decomposition, from the VAR system serve to show the response of *emp* to innovations (shocks) in the other two variables *viz*. domestic credit and interest rate differential. The VAR system also permits the study of feedback relation from *emp* to domestic credit and interest rate differential (not possible under single equation models). Lagged interaction among the variables is studied using Granger causality. Tanner (2002) extends Tanner (2001) to cross-country analysis of 32 countries, with relative more focus on monetary policy in the wake of currency crisis.

The possibility to study the feedback relationship makes VAR framework especially suitable for the analysis of the interaction between *emp* and monetary variables if the authorities plan to practice sterilization. While dilating upon the advantages of VAR framework Kamaly and Erbil (2000) notes that there are two sources of endogeneity in the *emp* model. First, the possible effect of *emp* on domestic credit in case of sterilization and Second, in case of interest rate defense, interest rate would react to *emp* changes. Of the two sources of endogeneity, the first one has been recognized by GR but they chose not to take care of it at the estimation stage. As noted earlier VAR framework circumvents the endogeneity problem.

Kamaly & Erbil (2000), uses *emp* model (GR in spirit) to gauge the degree of monetary independence and policy reaction to *emp.* The study is cross-country in nature and includes MENA region countries *viz*. Turkey, Egypt and Tunisia. Kamaly and Erbil (KE) like Tanner uses VAR framework. Allgebriacally, KE's system is:

$$y_t = \sum_{J=1}^{P} A_J y_{t-j} + Z_t + \pi_t^* + \mu_t \qquad (3.6)$$

Where $y_t$ = [ $emp_t$, $dc_t$, $\rho_t$ ] and $\mu_t$ is the error term matrix with variance covariance matrix $\sum_u$ which is symmetric.

KE's system has five variables: three endogenous and two exogenous. The endogenous variables are: exchange market pressure ($emp_t$), domestic credit ($dc_t$) and interest rate differential ($\rho_t$) while deviation from purchasing power parity rule ($z_t$) and international inflation ($\pi_t^*$) are the two exogenous variables

Tanner's system is similar to KE's system, except that Tanner assumes that $z_t$ & $\pi_t$* equals zero. It's worth recalling here that Lee's (1992) unrestricted model which was found to perform better than GR's restricted model also allows for deviation from purchasing power parity (like KE) and for domestic and foreign interest rates to grow at different rates (like Tanner and KE). Lee's alternate to GR model, which again is found to be superior, also posits that though foreign money supply growth influences e$mp_t$, these disturbances are transmitted through international inflation (as modeled by KE) and growth of interest rate differential (as modeled by Tanner and KE). Thus Tanner's and KE's frameworks are closer in spirit to Lee's alternate to GR's model. Again it is worth recalling that statistical test (i.e. Davidson-Mackinon test) performed by Wohar & Lee (1992) holds. Wohar & Lee's model superior to GR's model. It may be mentioned that Tanner as well as KE acknowledge that the derivation of the system yields real income as an explanatory variable. However they abstracted from using it in the model estimated on the ground that monthly data on real income is not available for most of the countries included in their study. Tanner also acknowledges that industrial production could be used as a proxy, for real income, but again he refrains from using it due to non-availability of data for all the countries included in his study.

It is worth noting that KE's derivation of the *emp* model, among other variables, yields domestic interest rate in the final model. However while performing empirical investigation KE use interest rate differential rather than domestic interest rate. They forward following two reasons to record their preference for interest rate differential over domestic interest rate. First, interest rate differential, according to KE serves better than domestic credit, as a gauge to measure the stance of monetary policy because movement in international interest rate that does not essentially correspond to change in domestic monetary policy, could induce movement in domestic interest rate. Hence, using interest rate differential enables to abstract from changes in domestic interest rate caused by global factors. Second, interest rate differential is more suitable variable to assess the

degree of monetary independence because the degree of monetary independence is measured by the authority's ability to derive a wedge between the domestic rate and the foreign one. KE's first argument, in favour of using interest rate differential rather than domestic interest rate, seems valid for an economy with higher degree of capital mobility. In a country, like Pakistan, where degree of capital mobility is low, there is not enough justification for deviating from the form the equation derived.

**2.3 Test for determining Monetary Autonomy**

KE develops a specific test to judge the degree of monetary autonomy enjoyed by the authorities, rather than merely relying on the coefficient of domestic credit to draw inference about the level of monetary autonomy. They work out coefficient of variation (Standard deviation/Mean) for exchange rate and foreign reserves series to test for monetary independence. The Coefficient of variation shows whether exchange rate changes or foreign reserves changes are dominant. Dominance of reserves changes imply that the managed float is tilted towards fixed regime i.e. the degree of monetary autonomy is low (in other words money supply is exogenous, in relative sense). Dominance of exchange rate changes on the other hand implies higher degree of monetary autonomy. Besides the coefficients of the KE's VAR system also sheds light on degree of monetary autonomy. Smaller coefficients for domestic credit and interest rate differential indicate higher degree of monetary autonomy. Besides if the exogenous variable, viz. $z_t$ & $\pi_t^*$ are significant in *emp* equation with correct signs, than this implies that economy is open enough (i.e. monetary autonomy is high) to be affected by deviation from PPP rule and world inflation.

Besides, Tanner (2002), constructs an intervention index to measure the degree of monetary autonomy (This is another test, besides KE's coefficient of variation, specifically meant to test the degree of monetary autonomy). He defines intervention index as the variance of (scaled) reserve changes *r* over the of sum of the variance of scaled reserve changes and exchange rate changes *e*. Algebraically Tanner's intervention index is expressed as:

$$\text{Intervention Index} = \text{Var } r \,/\, [\text{Var } r + \text{Var } e] \qquad (3.7)$$

Intervention index thus summarizes the degree of exchange market intervention. Under fixed exchange rate regime intervention index is unity. Closer the intervention index is to zero greater is the monetary autonomy that the authority enjoys.

### 3.4 Measures of exchange market pressure

Besides facilitating the establishment of relationship between the external account and the monetary policy, the measure of exchange market pressure has been used, by different authors for, predicting currency crises, constructing an index of exchange market pressure and evaluating the effectiveness of central bank intervention in foreign currency market. The measures of exchange market pressure proposed by different authors are summarized below.

Table: 3.1
Measures of Exchange Market Pressure

| **Authors** | **Measures of exchange market pressure** |
|---|---|
| Girton and Roper (1977) | Sum of exchange rate depreciation and changes in foreign reserves scaled by monetary base |
| Kamin, Schindler and Samuel (2001) | Two-months weighted average percentage change in the **real exchange rate** and in international reserves, with weights being proportional to the inverse of standard deviation of these series. |
| Kaminsky, Lizondo and Reinhart (1998) | Weighed average of monthly percentage change in the **nominal exchange rate** and in international reserves, with weights chosen to equalize the conditional variance of the two series. |
| Eichengreen, Rose and Wyplosz (1995) | Weighted average of the percentage change in **nominal exchange rate, foreign reserves and interest rate** with weights being proportional to the inverse of standard deviation of these series. |
| Frankel and Rose (1996) | Weighted average of annual percentage change in nominal exchange and foreign reserves with weights being proportional to inverse of standard deviation of these series. |
| Weymark (1995) | Excess demand for a currency in international market as the exchange rate change that would have been required to remove the excess demand in the absence of exchange market intervention, given the expectations generated by the exchange rate policy actually implemented |

### 3.5 Empirical Evidence on *emp* model

Results obtained by GR and six others who have tested the GR's exchange market pressure model (or a variant of it) are reproduced in table 3.2

Table 3.2
Empirical Evidence: *emp* Model

| Authors | Data Span | d | h/ θ | y | y* | p* / id | m | q |
|---|---|---|---|---|---|---|---|---|
| G-R (1977) | 52-74 | -0.96 (12.74) | 1.14 (4.86) | 2.80 (3.01) | -2.84 (3.59) | | | 0.92 |
| C-S (1979) | 55-75 | -1.009 (7.417) | | 1.268 (1.262) | | 1.285 (1.266) | | 0.68 |
| Modeste (1981) | 72-78 | -1.18 (-3.23) | | 0.65 (1.38) | | 1.078 (1.59) | | 0.60 |
| Kim (1985) | 80-83 | -0.699 (5.92) | | 0.057 (3.50) | | 0.952 (1.58) | -0.557 (-5.89) | 0.56 |
| Paradhan (1989) | 76-85 | -0.551 (3.8) | | 0.02 (1.19) | | 1.1 (1.68) | -0.675 (-1.85) | 0.35 |
| Wohar & Lee (1992) | | -0.804 (-1.13) | 1.086 (8.84) | 1.346 (2.83) | -2.343 (-1.53) | -1.322 (-1.84) | -0.298 (1.13) | 0.92 |
| Thornton (1995) | 86-92 | -0.92 | | 0.43 | | 4.30 | -0.8463 | 0.77 |

Notes:
Results of the regression with $e + r$ as the dependent variable are reported in the table.
Results of Q are from a different regression. To conserve space only results in respect of Q are reported.
Values in parenthesis are *t*-statistics.
d= domestic credit, h = Foreign money supply, θ = deviation from PPP rule,
y = domestic real income, y* = foreign real income, p* =foreign price level
id = interest rate differential (for Lee's results) and m = domestic money supply
Countries' studied by respective authors are: G-R: Canada, C-S: Brazil, Modeste: Argentina, Kim: Korea, Paradhan *et al*.: India, Lee: Japan, Thornton: Costa Rica

The results tabulated in Table 3.2 above are discussed below.

#### 3.5.1 **Does the exchange market pressure model supports monetary approach?**

In all cases examined the coefficient of domestic credit has the correct (negative) sign and is significant. Except for Korea (Kim) and India (Paradhan) the coefficient has value of close to unity. This evidence supports the monetarist contention that, increase in money supply causes reserves outflow and exchange rate depreciation. Real income variable ($y$) carries the correct sign in all cases but the value of coefficient is not close to unity for all cases. Foreign price level ($p^*$) carries the correct sign and value of the coefficient is close to unity in all the cases. By and large, results from exchange market pressure model are supportive of monetary approach.

3.5.2 *Monetary independence*

According to GR the estimated coefficient of -0.96 for domestic credit implies that, for Canada, when under fixed exchange rate regime, it is difficult to pursue an independent monetary policy, because any change in domestic credit will have an offsetting effect on foreign reserves, given the coefficients of -0.96 for domestic credit in the *emp* equation. However the GR's conclusion is valid when fixed exchange rate regime was practiced. GR's data span involve periods of floating as well fixed regime in Canada. The GR test, of monetary independence, does not tell anything about the degree of fixity of the exchange rate, when technically the regime was floating (but was being managed in practice). Hence it is difficult to draw conclusion for monetary independence in Canada during the periods of floating regime covered by GR's sample period.

3.5.3 *Sensitiveness of emp to its composition*

All the seven authors listed in the table have tested, whether the magnitude of exchange market pressure is sensitive to its composition (between exchange rate and foreign reserves). GR uses an additional variable Q = e/r for the purpose, others use Q = (e-1) / (r-1). Insignificance of Q implies non-sensitivity. Except for Lee (for Japan) and Paradhan et. al. (for India) all find that *emp* is not insensitive to is composition. This, according to GR implies that *emp* can be used to determine the magnitude of intervention required for achieving a target exchange rate. This conclusion obviously does not hold for India and Japan, where during the sample period, *emp* is sensitive to its composition.

*3.5.4 Efficacy of exchange market pressure model*

CS and those estimating the exchange market pressure model after them, have tested the efficacy of the exchange market pressure model, by using *r* as the sole dependent variable instead of the composite variable *r* + *e.* Except Lee (for Japan) and Paradhan et. al. (for India), all others report that the fit deteriorates with the use of *r* as the sole dependent variable. This proves the efficacy of the exchange market pressure model. Wohar and Lee and Paradhan *et al*. results also support the exchange market pressure model but in contrast to others they find that the fit remains more or less unchanged with the use of *r* as the sole dependent variable, however the fit deteriorates

extremely when *e* is used as the sole dependent variable. Both the authors conclude from this result that authorities have used reserve changes as the tool to cope with exchange market pressure. This, according to Lee partially explains the unexpected result (i.e. insignificance) in respect of variable Q obtained by the authors of the two papers.

It may be mentioned that one can draw some conclusion about the degree of monetary independence by using *r* and *e* in turn as the sole dependent variable. A relatively better fit with use of *r* shows preference for reserves adjustment that in turn implies a low degree of monetary autonomy. On the hand a better fit with the use of exchange rate as the sole dependent variable shows a preference for adjustment via changes in exchange rate. This implies a higher degree of monetary autonomy. Except GR and CS all have tested the model with the use of *e* (besides *r*) as the sole dependent variable. All report substantial deterioration in the fit upon use of *e,* implying a greater preference for adjustment in reserves relative to adjustment in exchange rate. This means that the tilt had been towards fixed exchange rate regime. Hence one may conclude that the degree of monetary autonomy has been relatively low in all the countries studied. This conclusion is implicit from the test conducted however the authors have not used the test for the purpose. A limitation of the test is that it only indicates whether the regime is tilted toward fixed or floating, but it does not provide a quantified measure of the degree of the tilt.

Paradhan *et al*. (1989) has tested the exchange market pressure model using effective exchange rate as well as (Indian) Rupee-Pound Sterling rate. The effective exchange rate is expressed in Index form computed by the weighted geometric average of the exchange rate of India's five major trading partners against the (Indian) Rupee with September 25, 1975 as the base (the day India adopted managed float). Besides, they use the narrow money supply ($M_1$) for estimation purpose. From results the authors' conclude that the explanatory power of the model is enhanced (slightly) when basket currencies definition is used instead of the Rupee-Sterling definition

Wohar and Lee (1992), as mentioned earlier, also estimates an alternate to GR model (which allows for foreign disturbance to be transmitted through change in foreign inflation rate rather than via direct growth in foreign money supply) Estimation reveals that all the coefficients are of correct sign. The important thing is that the foreign

inflation rate is insignificant. Combining this insignificance with the fact that the foreign money supply growth rate (in WL's version of GR's model) entered with a significant positive coefficient may suggest that foreign disturbances are transmitted to domestic money supply directly through increase in foreign money growth rather than foreign inflation rates.

Tanner (2001,2002) and Bautista & Bautista (2005) use the exchange market pressure model to study the relationship between monetary policy and exchange market pressure, with special focus on currency crisis. Tanner (2001) is a cross-country study that includes three countries each from Latin America and East Asia viz. Brazil, Chile, Mexico, Indonesia, Korea and Thailand. Bautista & Bautista (BB henceforth) is about Philippines. The three studies address questions that are identical in spirit.

The first question that the three studies raise is; does a contraction in monetary policy reduce exchange market pressure? The results obtained are generally supportive of the traditional theory, as there is positive and contemporaneous effect of domestic credit on *emp*. This also proves that exchange market pressure model validates the monetary approach.

The second issue that the three studies referred above examine is; do high interest rates or an increase in interest rate differential reduce exchange market pressure? Again, the results are supportive of traditional theory as there is negative correlation between interest rate differential and *emp*. However BB reports a positive impact of shock to interest rate differential on *emp* (this in conflict with the theory) for the sub-span 97:7-00-04 (currency crisis period)[7].

> "this leaves open the possibility of perverse effect in which higher interest rate increase rather than decrease exchange market pressure. It appears that during periods of currency crisis, a high domestic interest rate policy cannot be relied upon to deliver the usual results"

The third question addressed by the three studies referred above is: How do the monetary authorities respond to exchange market pressure? As a policy reaction function shocks to exchange market pressure effects domestic credit positively, this suggests that authorities respond, in general, to increased *emp* by providing additional liquidity (rather

[7] It is worth recalling here that BB's study is about Philippines and that the country was amongst the East-Asian economies that went through currency crises in late'90's.

than contracting it, as standard monetary framework predicts) to the banking system. Tanner (2001), suggests that the unexpected policy reaction function (increase in domestic credit upon increase in *emp*) could be due to either of the two reasons: First, this may represent an error in perception that results in a vicious circle, since an initial rise in *emp* may be due to a permanent fall in money demand, (or at least one that is likely to persist for long), that the central bank incorrectly perceives to be temporary.

Second such a policy reaction function may also reflect a weak financial system. For a central bank it may turn out to be politically unviable to let the unsound financial institutions, burdened with non-performing loans, fail. Thus the central bank might be constrained to provide the banking system with additional liquidity even if it leads to increase in exchange market pressure.

Third, Tanner (2002) and BB (2005) feel that the, lagged positive response from *emp* to domestic credit is suggestive of sterilized intervention. This, according to the authors, confirms a key element of both the Mexican and Asian crisis, namely that the monetary authorities sterilized foreign reserve outflows and responded to higher *emp* by providing additional liquidity to the banking system rather than contracting it.

BB, besides observing positive response from *emp* to domestic credit for their full data span, also find a negative response from *emp* to domestic credit in the sub-span representing currency crises period (97:7-00:04). This result, according to BB suggests that the authorities evidently chose not to sterilize anymore. Thus the authority (in Philippines) behaved differently during the crises period and attempted to keep money tight in the face of extraordinary high exchange market pressure, possibly in an attempt to reduce or, at least not to worsen further the level of exchange market pressure.

Given the evidence on feedback from exchange market pressure to monetary policy, Tanner (2002) concludes as under:

> " monetary policy could be a powerful tool to defend a currency, provided that it is free to do so. However when constrained by other factors, expansionary monetary policy has been the culprit behind many recent episodes of exchange market turbulence".

Kamaly and Erbil (2000), a cross-county study that includes Turkey, Egypt and Tunisia finds a strong link between domestic credit and exchange market pressure. In addition, when the exchange market pressure rises, the authorities respond by increasing

both the domestic credit and interest rate. For Egypt the authorities use domestic credit as a policy reaction function but the direction of response is not clear from results. Tunisia uses interest rate changes as a policy tool in response to *emp* shocks. However the direction of response is again unclear from results.

In terms of monetary autonomy, tests result show that for Turkey the coefficient of variation is higher for exchange rate than for reserves while for Egypt and Tunisia the converse is true. This implies that Turkey exhibits a higher degree of monetary autonomy while Egypt and Tunisia enjoy low degree of monetary autonomy. Besides coefficients of the variables included in the VAR system also confirms this finding.

### 3.5.5 Sensitiveness to *ordering* of variables

VAR framework allows the imposition of exogeneity restrictions on the variables. Tanner ( 2001, 2002), BB (2005) and Kamaly and Erbil (2000) have tested their results for different orderings. The sensitivity tests show that by and large their results are robust.

## 3.6 Conclusion

Since the seminal work of Girton & Roper (1977), many studies have developed monetary models to look into the determinants of exchange market pressure. To estimate the model, the econometric technique used in earlier studies is OLS while recent works prefer VAR to account for the possible interactions amongst variables that appear in the *emp* model. Except few, most of the studies exclude real income and deviation from purchasing power parity, as an explanatory variable, from the model. Some studies do include these variables in theoretical framework but refrain from their use at the empirical stage, mainly on grounds of data availability.

A strand of literature on exchange market pressure is exclusively concerned with developing an index of exchange market pressure. Yet another strand uses one or the other index to predict currency crises or to determine the effectiveness central bank's intervention in foreign currency market. For examining the relationship of exchange market pressure mostly GR model has been used. Indices developed by Kamin, Schindler and Samuel (2001), Eichengreen, Rose and Wyplosz (1996), Kaminsky, Lizondo and Reinhart (1998) and Frankel and Rose (1996) have been mainly used to develop an early

warning system for the currency crises in offing. Weymark's (1995) index has been used mainly to examine the effectiveness of central bank's intervention in the foreign currency market.

By and large the studies that examine relationship between exchange market pressure and monetary policy, determine that contractionary monetary policy eases exchange market pressure. Despite this result, the studies that examine the feedback relationship from exchange market pressure to domestic credit find that the policy response to an increase in *emp* is, to expand domestic credit rather than contract it.

Bautista and Bautista (2005) that investigate the relationships between monetary policy and *emp*, find that the policy response to increase in *emp* (in Phillipines) is different in currency crises period and normal times. The authors argue that during normal times the authorities tend to behave imprudently and therefore expand domestic credit in response to increase in *emp*. However during currency crises periods the behaviour of authorities is more responsible as reflected in the contractionary monetary policy adopted in response to extraordinary increase in exchange market pressure.

## Theoretical Framework

### 4.1 Introduction

Exchange market pressure (*emp*) is defined as sum of exchange rate depreciation and foreign reserves outflow scaled by monetary base. Thus the two components of exchange market pressure are: Foreign reserves outflow and exchange rate depreciation. These components are the isolated focus of two theories; Monetary Approach to Balance of Payment and Monetary Approach to Exchange Rate.

The monetary approach to BOP focuses upon variation in foreign reserves while the monetary approach to exchange rate pays attention to changes in exchange rate. Given this, it is logical to draw upon the two approaches for building a unified theoretical framework for the exchange market pressure model.

The monetary approach to balance of payments[8] (BOP) holds that BOP deficit or surplus reflects disequilibrium in the money market and that outflow or inflow of foreign reserves corrects any disequilibrium in money market. The approach is built on the assumption, that demand for money is a stable function of certain variables, at least, over a period of a year or two (Mussa, 1976). This money demand function constrains the equilibrium size of money supply. If there is change in one of the arguments of money demand function that causes increase in money demand, and the domestic source component (i.e. domestic credit) of money supply is not increased then according to monetary approach to balance of payments the country will experience a BOP surplus and there will be pressure on exchange rate to appreciate. Under fixed exchange rate regime, the countries, being committed to maintain par value of their currencies, will be forced to purchase foreign currency from market and thereby to increase the foreign source component of money supply. This intervention is necessitated to prevent appreciation of exchange rate.

On the other hand if the monetary authority causes an increase in domestic source component of money supply without any change in money demand the result would be an excess of money supply. This would create pressure for depreciation of exchange rate,

[8] For exposition of the monetary approach we have made use of Frenkel (1976) Mussa (1976) and Pilbeam (1999)

forcing the monetary authority to contract the foreign source component of money supply by the amount of increase in domestic source component.

Slight tinkering with the theory of balance of payments under fixed exchange rate, yields the theory of exchange rate under pure float. Under flexible exchange rate regime, the foreign source component of money supply is fixed. Hence if there is change in one of the arguments of money demand function or in the domestic credit component of money supply, equilibrium cannot be achieved by induced change in foreign reserves. Instead the exchange rate adjusts. This adjustment affects the variables that enter into money demand function: real income and interest rate. Ultimately, the exchange rate must change sufficiently to bring the money demand in equilibrium with money supply.

The monetary theory of balance of payments and the theory of exchange rate under managed exchange rate regime is a combination of the two simple theories discussed above. Under this regime the monetary authority actively intervenes in forex market but does not seek to maintain fixed rates. A change in demand for money relative to supply available from domestic credit sources, or vice versa, puts pressure on the exchange rate. The monetary authority must decide the extent to which this pressure will be relieved by allowing the exchange rate to change and the extent to which it will be absorbed by variations in foreign reserves of the central bank. The extent of initial monetary disequilibrium determines the magnitude of total adjustment required.

**4.2 Monetary Equilibrium**

It is apparent from the foregoing discussion that monetary theory hinges upon monetary equilibrium condition. It is also clear that exchange market pressure model is nothing but a synthesis of monetary approach to balance of payments and monetary approach to exchange rate. Therefore to develop a framework for the determinants of EMP we start with simple model of monetary equilibrium given by:

$$Ms = Md \qquad (4.1)$$

Where;

$Ms$ stands for Money supply and $Md$ denotes real money demand.

### 4.2.1Money Supply

Money supply is given by:

$$Ms = m(F_t + D_t) \qquad (4.2)$$

Where;

$m$: money multiplier, F: international reserve component of Monetary Base, D: Domestic credit,

Quite often in empirical studies that examine the relationship between exchange market pressure and the monetary policy, the money multiplier is assumed to remain constant and is therefore excluded from the model. The reason is that the objective being to gauge the response of the monetary authority to exchange market pressure, the use of such a measure of monetary policy is appropriate that is under the complete control of the central bank. This measure is Reserve money ($M_0$), also known as monetary base. On the other hand the inclusion of the money multiplier in the money supply identity requires the use of $M_1$ or $M_2$ upon which the central bank does not enjoy complete control because these are influenced by the market participants as well, besides the central bank. Therefore we need to exclude the money multiplier from the money supply identity. Kaminsky & Reinhart (1999) use excess $M_1$ balances as an indicator of monetary stance but they find it to be a noisy indicator, that is, the response contains elements other than those of the monetary authority. It is precisely this noise that we seek to avoid when we exclude money multiplier from our formulation. Finally its worthwhile to mention that fore runners like Tanner (2001, 2002) Kamaly & Erbil (2000) and Girton & Roper (1977) etc. who have conducted similar studies have also excluded money multiplier from their model.

Given the foregoing discussion we exclude the money multiplier from our formulation. Hence our money supply identity is given by:

$$M_S = F + D \qquad (4.3)$$

The money supply referred to in equation (4.3) constitutes the monetary base.

### 4.2.2 Money Demand

Like money supply identity, our money demand function is also similar to the one used by Girton & Roper (1977) and Kamaly and Erbil (2000). Demand for base money is given by:

$$Md = P_t Y_t^{\beta} e^{-\alpha i} \qquad (4.4)$$

Where;

P: price level, Y: Real income, $i$: Nominal interest rate, $\alpha$ and $\beta$ are parameters, with $\beta > 0$ and $\alpha < 0$.

Money demand function used in equation (4.4) exhibits a positive relation between real income and money demand and a negative relationship between interest rate and money demand. This relationship is described by Keynes's theory of money demand Keynes (1936)[9] suggested three motives for holding money (i) transaction motive, (ii) precautionary motive and (iii) speculative motive. The transaction motive refers to the money as medium of exchange and represents money in active circulation. It arises from the fact that economic agents do not usually enjoy perfect synchronization between their streams of revenue (income) and their streams of expenditure. Economic agents normally do not pay all their bills on payday; therefore they need money for executing transactions between paydays. The aggregate demand for transaction balances is roughly proportional to national income. Precautionary balances enable people to meet unanticipated increase in expenditure prompted by such developments as illness. In addition precautionary balances also enable people to take advantage of unanticipated good bargains. The total amount of money held for precautionary purpose, like transaction demand, is primarily a function of national income. Therefore we may combine precautionary balances with transaction balances and consider their sum to be roughly proportional national income. This is depicted in money demand function given by equation (4.4). To this extent Keynes theory of money demand is similar, in spirit, to Fisher's equation of exchange and the Cambridge approach (to money demand) discussed under literature review.

Keynes was the first to introduce interest rate variable in the money demand function. According to him, besides the transaction and precautionary motive, economic agents hold money out of fear of capital loss (speculative motive): when market interest rate registers an increase the price of existing bonds declines. The reason is that the existing bonds that carry relatively low rate of interest become less attractive after the interest rate hike. To equalize the yield on such bonds with current market interest rate, the price of existing bonds must decline. When bond prices decline, bondholders incur capital loss.

[9] Cited in Mishkin and Eakins (1998)

Keynes assumed that interest rate gravitates to sum value, or perhaps, a range of values considered as normal (Mishkin and Eakins, p.536). When the current interest rate is above the normal range there is tendency for people to expect, that the rate will fall and vice versa. As the relationship between bond price and interest rate is negative, when the current interest rate is below the perceived normal range and it is expected to rise; therefore bond prices will decline and those holding bond will incur capital loss. So, when current interest is low, economic agents, out of fear capital loss, shift from bonds to money, thereby increasing money demand. Thus the relationship between current interest rate and speculative demand for money is negative: when current interest rate are low money demand is high and vice versa. This relationship is shown in money demand function used in equation (4.4).

Boumal (1952)[10] and Tobin (1956) independently developed demand for money models. Though their model specifications are slightly different from the one given by (4.4). However the central message of their analysis regarding interest rate is relevant here. According to Boumal-Tobin analysis there is an opportunity cost of holding money, which is the interest rate that can be earned on other assets. Besides there is a benefit to holding money; the avoidance of transaction costs. Thus increase in interest rate will lead to increase in opportunity cost of holding money. Therefore with increase in interest rates people will decrease their holding of money and vice versa. Thus Boumal-Tobin analysis shows that even the transaction demand for money balances is sensitive to interest rates.
Substitution of money supply and money demand from equation (4.3) and (4.4) respectively in monetary equilibrium condition given by equation (4.1) yields:

$$F_t + D_t = P_t Y_t^{\beta} e^{-\alpha i} \qquad (4.5)$$

Where:
The Left-hand side of (4.5) reflects money supply (the monetary base) where (F) and (D) are the foreign and domestic components of money supply. The right-hand side reflects demand for base money. (To simplify the notations, we exclude the time subscript *t* to derive the reduced-form equation. The subscript reappears in the reduced-form equation).

[10] Cited in Mishkin and Eakins (1998)

### 4.3 Deriving the *emp* Model:

The task at hand is to develop an expression for exchange market pressure whose components are the foreign reserves outflow and exchange rate depreciation. As (4.5) contains the foreign source component of monetary base therefore one component of the exchange market pressure can be recovered from (4.5). We proceed with algebraic manipulation of (4.5) with this end in end mind.

Taking log of (4.5), we have:

$$\log(F + D) = \log P + \beta \log Y - \alpha i \qquad (4.6)$$

Differentiating the above with respect to time we have:

$$\frac{\dot{F} + \dot{D}}{F + D} = \frac{\dot{P}}{P} + \beta \frac{\dot{Y}}{Y} - \alpha \dot{i} \qquad (4.7)$$

Where the dot on the variables denotes the derivative of the variables with respect to time.

By definition F:

$$\dot{F} = \dot{E}\dot{R} \qquad (4.8)$$

Where $E$ denotes nominal exchange rate and R is the nominal value of reserves in foreign currency. Thus equation (4.8) is used to express the change in value of foreign reserves in domestic currency. However to make the changes in reserves comparable overtime we need a real rather than a nominal measure of change in reserves. To accomplish this end we scale the Rupee value of change in reserves with monetary base. The algebraic required to accomplish the end follows.

Replacing ($\dot{F}$) in (4.7) with ($\dot{E}\dot{R}$) from (4.8) and using the fact that $F$+$D$ together constitute monetary base (H ), we get;

$$\frac{\dot{E}\dot{R}}{H} + \frac{\dot{D}}{H} = \frac{\dot{P}}{P} + \beta \frac{\dot{Y}}{Y} - \alpha \dot{i} \qquad (4.9)$$

Let:

$$\frac{\dot{ER}}{H} = r$$

$$\frac{\dot{D}}{H} = dc \qquad (4.9\ a)$$

$$\frac{\dot{P}}{P} + \beta \frac{\dot{Y}}{Y} - \alpha \dot{i} = md$$

Where:
*r*: change in foreign reserves (Rupee value) as percentage of monetary base
*dc*: change in domestic credit as percentage of monetary base
$md$ : Change in real money demand

Given new notations (4.9) can be written as:

$$dc + r = md \qquad (4.10)$$

We extract the change in foreign reserves scaled by monetary base by rewriting equation (4.10) as:

$$r = md - dc \qquad (4.11)$$

Where r is the change in foreign reserves scaled by monetary base. Equation (4.11) expresses foreign reserves changes as an inflow. It is more convenient for our purpose to express reserves changes as an outflow. This can be done by multiplying equation (4.11) with –1 to yield:

$$-r = r' = dc - md \qquad (4.12)$$

Equation (4.12) states that the outflow of foreign reserves equals the difference between change in domestic component of the monetary base (dc) and the change in demand for base money. Equation (4.12) gives us one of the components (i.e. reserves outflow) of exchange market pressure. To complete the formation of the composite variable viz. exchange market pressure (*emp*) we add exchange rate depreciation, ($\dot{E} = e$) to both sides of (4.12).This yields:

$$r' + e = dc - md + e \qquad (4.13)$$

Left-hand side of equation (4.13) represents our composite variable exchange market pressure, where ($r'$) is foreign reserves outflow scaled by monetary base and ($e$) is exchange rate depreciation (in percent).

Let $r' + e = emp$, where *emp* stands for exchange market pressure. Given the new notations (4.13) can be written as:

$$emp = dc - md + e \qquad (4.14)$$

Though we have completed the formation of the composite variable: a problem with equation (4.14) is that exchange rate depreciation ($e$) appears on both sides of the equation (on the left hand side it is included in *emp* as a component). So we are left with the task of eliminating ($e$) from right hand side of (4.14). We proceed ahead to do the needful.

If nominal exchange rate is at its equilibrium level then there will be no tendency for the exchange rate to change and the forex market is in equilibrium. However, when nominal rate deviates from its equilibrium value then there is pressure on the exchange rate to vary and this causes disequilibrium in forex market/money market. Given that the deviation from some equilibrium exchange rate explains disequilibrium in money market i.e. exchange market pressure, the said deviation should be included as an explanatory variable in an equation like (4.14). Following Wohar & Lee (1992) Tanner (2001,2002) and Kamaly and Erbil (2000) we use purchasing power parity to measure the deviation of nominal exchange rate from the equilibrium rate.

PPP theory, associated with Cassel (1916) is based on the idea that a certain amount of money should purchase the same representative bundle of commodities in different countries. There are two versions of PPP theory: the absolute version and the relative version. The absolute version of PPP theory states that the equilibrium rate of exchange is equal to the ratio of domestic to foreign price level. Relative version predicts that change in inflation differential between two countries is equal to the change in nominal exchange rate. Given that we want to examine the variable, exchange market pressure, whose one component is the nominal exchange rate use of the relative version of PPP suits our purpose. It's worth mentioning here that the PPP theory has remained a

controversial topic through the years. Abundant evidence exists on both sides of the fence.[11]

For the construction of exchange market pressure model we are more concerned with the question, does the nominal exchange rate deviate from the PPP rate at a specific moment in time. In other words we are concerned with deviation from PPP rate in short run rather than the issue whether or not PPP holds in the long run. If the nominal rate does deviate from the PPP rate in the short run, then the deviation exerts pressure on exchange rate to move towards equilibrium value, that is, the PPP rate. It's worth noting here that Tanner (2001) recognizes that deviation from PPP should be incorporated into the model but assumes that PPP holds and therefore excludes the deviation from the model. On the other hand Wohar Lee (1992) and Kamaly and Erbil (2002) do not assume that PPP holds and therefore include the deviation from PPP in the model. Given the evidence, available in literature, in favour of short run deviation from PPP, we assume that the nominal exchange rate does deviate from it's PPP value at a specific moment in time. Having assumed that deviation from PPP rate does exist we proceed to incorporate the deviation in the model.

The essence of relative PPP is that the change in inflation differential between two countries equals the change in nominal exchange rate. This can be expressed as:

$$e = \pi - \pi^* \qquad (4.15)$$

Where:

$\pi$: Domestic inflation

$\pi^*$: International inflation

If the change in nominal exchange rate does not equal inflation differential, then we can add another variable to the R.H.S. of (4.15) to represent the deviation from PPP. Hence:

$$e = \pi - \pi^* + z \qquad (4.16)$$

Where:

[11] For exhaustive survey of empirical evidence for and against PPP see Moosa and Bhatti (1997).

$z$: stands for Deviation from Purchasing Power Parity (PPP) rate

Substituting the value of $e$ from (5.16) into (5.14) yields:

$$emp = dc - md + \pi - \pi^* + z \qquad (4.17)$$

Substituting the value of change in real money demand (*md*) from (4.9a) into (4.17), this yields:

$$emp = dc - \left[\frac{\dot{P}}{P} + \beta\frac{\dot{Y}}{Y} - \alpha\dot{i}\right] + \pi - \pi^* + z \qquad (4.18)$$

Let $\frac{\dot{Y}}{Y} = y$ and given that $\frac{\dot{P}}{P} = \pi$ then:

$$emp = dc - \pi - \beta y + \alpha\dot{i} + \pi - \pi^* + z \qquad (4.19)$$

or

$$emp = dc - \beta y + \alpha\dot{i} - \pi^* + z \qquad (4.20)$$

Including the time subscript deleted earlier:

$$emp_t = dc_t - \beta y_t + \alpha\dot{i}_t - \pi_t^* + z_t \qquad (4.21)$$

Equation (4.21) specifies our economic model in reduced-form. For convenience of the reader notations of (4.21) are explained once again:

$emp_t$ : Exchange Market Pressure at time *t*,
$dc_t$ : Growth in domestic credit (scaled by monetary base)
$y_t$ : Percentage growth in real income
$i_t$ : growth in nominal interest rate
$\pi_t^*$ :Percentage growth in international inflation
$z_t$ : Deviation from PPP rate

The equation (4.21) states that exchange market pressure is positively related to domestic credit, domestic interest rate and deviation from purchasing power parity. On the other hand real income and international inflation affects the exchange market pressure negatively.

# 5 Empirical Framework

Our theoretical framework, discussed at length in previous chapter, yields the following model.

$$emp_t = dc_t - \beta y_t + \alpha \dot{i}_t - \pi_t^* + z_t \qquad (4.21)$$

Our task here is to develop an empirical framework for the model given by (4.21)

The overriding econometric problem that needs to be tackled while devising the empirical framework for our model given by (4.21) is that of endogeneity contained in (4.21). In this chapter we discuss the sources of endogeneity contained in (4.21), the econometric problem involved in estimation of endogenous systems and the methodologies of tackling it, the appropriate empirical framework for our model and finally the hypotheses of the study.

## 5.1 **Sources of endogeneity in *emp* model**

Our model given by (4.21) exhibit the following sources of endogeneity.

(i) Possible effect of exchange market pressure on domestic credit in case of sterilization.

The theoretical framework, summarized by equation (4.21) shows the positive influence of domestic credit ($dc_t$) upon exchange market pressure ($emp_t$). Given this relationship, if the monetary authority wants to contain exchange market pressure it can decrease domestic credit. Besides at times, if the capital inflows are too to be absorbed the authorities may sterilize such inflows by increasing domestic credit. These policy options imply that exchange market pressure may also influence domestic credit. The possibility of two way interaction described above makes the model (4.21) endogenous.

(ii) Possible effect of exchange market pressure on interest rate.

Our exchange market pressure model given by (4.21) shows the influence of domestic interest rate upon exchange market pressure: interest rates may increase due to higher demand for money. The increase in interest rate has an indirect effect on level of money supply as well. The increase in domestic interest rate relative to international rate encourages inflow of foreign capital i.e. lowers exchange market pressure. In this case it is the interest rate that influences exchange market pressure. However the direction of influence between interest rate and exchange market pressure could work the other way

round as well. For example, when faced with high exchange market pressure authorities may choose to curb such pressure by influencing upward movement in interest rate. Increase in interest rate will encourage capital inflows, bolster foreign reserves and thereby reduce exchange market pressure. In this case, as opposed to the previous one, it is the exchange market pressure that influences interest rate. Thus this is a clear case of endogeneity.

(iii) Possible effect of real income on interest rate

Monetary theory holds that real income influences reserves or exchange rate or some combination of the two (see section 2.1.3). However if the exchange market pressure changes due to some exogenous inflows or outflows then this would change the exchange rate parity. The change in exchange rate parity would affect real income through change in competitiveness. Thus the exchange market pressure would influence real income rather than real income influencing exchange market pressure as specified by equation (4.21). Thus this is a case of endogeneity.

### 5.1.1 **Endogeneity-Econometric problem**[12]

First choice of a researcher using regression analysis is to estimate a single-equation model using ordinary least square (OLS). However in single-equation models an implicit assumption is that there exist one-way relationship between the explanatory and the dependent variable; the explanatory variable being the cause and dependent variable being the effect. However in many situations there exists a two-way relationship between the explanatory and the dependent variables that is *x's* affect y and some of the *x's* in turn are influenced by y. The mutually or jointly dependent variables are referred to as endogenous variables and the models incorporating such variables are called simultaneous equation models.

In an endogenous system there is more than one equation — one for each of the endogenous variables. In such models, it is inappropriate to estimate the parameters of a single equation without taking into account the information contained in other equations of the system. To understand the logic, we need to recall that one of the crucial

[12] For note on endogenous systems, we lean on Gujrati (1998, pp. 634-36)

assumption of OLS method is that the explanatory variables are either non-stochastic or if stochastic (random) are distributed independently of the stochastic disturbance term. If neither of these conditions is met, then it can be shown that the least-squares estimators are not only biased but inconsistent, as well (Gujrati, 1998). That is, as the sample size increases indefinitely, the estimators do not converge to their true (population) values.

Given the endogeneity problem discussed above, and the fact that our system given by equation (4.21) has endogeneity, it is apparent that it is not appropriate to estimate the system using OLS.

### 5.1.2 **Tackling Enodogeneity**

A commonly used method to estimate a system, like the one given by equation (4.21), is that of endogenous or Structural equation models. In endogenous or structural equation models some variables are treated as endogenous and some as exogenous. Before estimation, it has to be ensured that equations in the system are identified (either exactly or over). The identification is done by assuming that some of the exogenous variables are present in only some of the equations. This decision is often subjective and is criticized in Sims (1980, p.2). Given the limitation of simultaneous (i.e. endogenous) equation models that all endogenous variables are not treated at par, such models are less appropriate, if not entirely unsuitable for estimation of the system given by equation (4.21). It is in this spirit that Sims developed the Vector autoregression (VAR) method that is well suited to estimation of simultaneous equation models[13]. The main tool of analyzing the results of a VAR system is the impulse response function (IRF). We proceed ahead to develop the empirical framework for our economic model given by (4.21) using vector autoregression and vector moving average (IRF's).

## 5.2 **VAR Form of *emp* model[14]**

Vector autoregression requires that variables of the system, to be estimated, be either stationary or cointegrated. If the variables are stationary, unrestricted VAR is to be

[13] We would like to caution the reader at the outset that while *choleski ordering* (explained in section 5.4) of variables and robustness of results to different *orderings* may go some way in addressing the endogeneity issue, however, these may not completely solve the problem, because the endogeneity problem may not essentially go away with a particular *ordering* of variables.

used while cointegrated variables call for use of error correction model. Assuming that all the variables are stationary the model can be formulated by unrestricted VAR. The VAR approach treats each endogenous variable in the system, as a function of the lagged values of all of the endogenous variables in the system.

The mathematical form of a VAR is:

$$q_t = A_1 q_{t-1} + ..... + A_p q_{t-p} + \beta s_t + \varepsilon_t \qquad (5.1)$$

Where $q_t$ is a *k* vector of endogenous variables, $s_t$ is a *d* vector of exogenous variables, $A_1,...,\ A_P$ and $\beta$ are matrices of coefficients to be estimated, and $\varepsilon_t$ is a vector of innovations. The VAR approach to estimation assumes that innovations are uncorrelated with their own lagged values and all the right-hand side variables. However the innovations may be correlated with each other. Since only lagged values of the endogenous variables appear on the right-hand side of each equation, therefore there is no issue of simultaneity, and OLS is the appropriate estimation technique. The assumption that the innovations are not serially correlated is taken care of by adding more lagged *q's* (dependent variables') till the serial correlation is removed (Tanner, 2002).

As discussed under theoretical framework (Chapter 4) our model has four endogenous variables viz. ($dc_t$), interest rate ($i_t$) Real income ($y_t$) and exchange market pressure ($emp_t$) and two exogenous variables viz. international inflation ($\pi_t^*$) and deviation from purchasing power parity ($z_t$). Thus $dc_t$, $i_t$ $y_t$ and $emp_t$ together constitute $q_t$ and $\pi_t^*$ and $z_t$ constitute $s_t$ in equation (5.1).

Suppose that $dc_t$, $i_t$ $y_t$ and $emp_t$ are jointly determined by the following VAR system:

$$dc_t = b_{10} - b_{12} i_t - b_{13} y_t - b_{14} emp_t + \gamma_{11} dc_{t-1} + \gamma_{12} i_{t-1} + \gamma_{13} y_{t-1} + \gamma_{14} emp_{t-1} + \varepsilon_{dc\,t} \qquad (5.2)$$

$$i_t = b_{20} - b_{21} dc_t - b_{23} y_t - b_{24} emp_t + \gamma_{21} dc_{t-1} + \gamma_{22} i_{t-1} + \gamma_{23} y_{t-1} + \gamma_{24} emp_{t-1} + \varepsilon_{i\,t} \qquad (5.3)$$

$$y_t = b_{30} - b_{31} dc_t - b_{32} i_t - b_{34} emp_t + \gamma_{31} dc_{t-1} + \gamma_{32} i_{t-1} + \gamma_{33} y_{t-1} + \gamma_{34} emp_{t-1} + \varepsilon_{y\,t} \qquad (5.4)$$

$$emp_t = b_{40} - b_{41} dc_t - b_{42} i_t - b_{43} y_t + \gamma_{41} dc_{t-1} + \gamma_{42} i_{t-1} + \gamma_{43} y_{t-1} + \gamma_{44} emp_{t-1} + \varepsilon_{emp\,t} \qquad (5.5)$$

[14] To explain VAR we make liberal use of Enders (1995), Chapter 5

The system given by equation (5.2)-(5.5) allows the four endogenous variables viz. $dc_t$ $i_t$ $y_t$ and $emp_t$ to affect each other. For example, $-b_{12}$, $-b_{13}$ $-b_{14}$ represents the contemporaneous effect of a unit change in $i_t$ $y_t$ and $emp_t$ on $dc_t$. The terms $\varepsilon_{dc_t}$, $\varepsilon_{i_t}$, $\varepsilon_{y_t}$ and $\varepsilon_{emp_t}$ are pure innovations (or shocks) in $dc_t$ $i_t$ $y_t$ and $emp_t$ respectively. The structure of the system is such that not only own innovations to the variables but the innovations to other variables as well, are also allowed to influence a variable. Thus the system incorporates feedback mechanism. For example if $b_{21,}$ $b_{31}$ and $b_{41}$ are not equal to zero then $\varepsilon_{i_t}$, $\varepsilon_{y_t}$ and $\varepsilon_{emp_t}$ have indirect contemporaneous effect on $dc_t$.

Using matrix algebra we can write the system of equation given by (5.2)-(5.5) in compact form as:

$$\begin{bmatrix} 1 & b_{12} & b_{13} & b_{14} \\ b_{21} & 1 & b_{23} & b_{24} \\ b_{31} & b_{32} & 1 & b_{34} \\ b_{41} & b_{42} & b_{43} & 1 \end{bmatrix} \begin{bmatrix} dc_t \\ i_t \\ y_t \\ emp_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \\ b_{30} \\ b_{40} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} \end{bmatrix} \begin{bmatrix} dc_{t-1} \\ i_{t-1} \\ y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{dc_t} \\ \varepsilon_{i_t} \\ \varepsilon_{y_t} \\ \varepsilon_{z_t} \end{bmatrix} \quad (5.6)$$

Or more compactly:

$$Bx_t = \Gamma_0 + \Gamma_1 x_{t-1} + \varepsilon_t \quad (5.7)$$

Where:

$$B = \begin{bmatrix} 1 & b_{12} & b_{13} & b_{14} \\ b_{21} & 1 & b_{23} & b_{24} \\ b_{31} & b_{32} & 1 & b_{33} \\ b_{41} & b_{42} & b_{43} & b_{44} \end{bmatrix}, \quad \Gamma_0 = \begin{bmatrix} b_{10} \\ b_{20} \\ b_{30} \\ b_{40} \end{bmatrix} \quad \Gamma_1 = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \lambda_{14} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \lambda_{24} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} \end{bmatrix},$$

$$x_t = \begin{bmatrix} dc_t \\ i_t \\ y_t \\ emp_t \end{bmatrix}, \text{ and } \varepsilon_t = \begin{bmatrix} \varepsilon_{dc_t} \\ \varepsilon_{i_t} \\ \varepsilon_{y_t} \\ \varepsilon_{z_t} \end{bmatrix}$$

Premultipy Equation (5.7) with $B^{-1}$. This gives us VAR in *Standard* form:

$$x_t = A_o + A_1 x_{t-1} + e_t \tag{5.8}$$

Where: $A_o = B^{-1}\Gamma_o$

$A_1 = B^{-1}\Gamma_1$

$e_t = B^{-1}\varepsilon_t$

To simplify the notations, we can define $a_{i0}$ as the element $i$ of vector $A_o$, $a_{ij}$ as the element in row $i$ of column $j$ of the matrix $A_1$ and $e_{it}$ as the element $i$ of vector $e_t$. Given the new notations, we can rewrite (5.8) as:

$$dc_t = a_{10} + a_{11}dc_{t-1} + a_{12}i_{t-1} + a_{13}y_{t-1} + a_{14}emp_{t-1} + e_{1t} \tag{5.9}$$

$$i_t = a_{20} + a_{21}dc_{t-1} + a_{22}i_{t-1} + a_{23}y_{t-1} + a_{24}emp_{t-1} + e_{2t} \tag{5.10}$$

$$y_t = a_{30} + a_{31}dc_{t-1} + a_{32}i_{t-1} + a_{33}y_{t-1} + a_{34}emp_{t-1} + e_{3t} \tag{5.11}$$

$$emp_t = a_{40} + a_{41}dc_{t-1} + a_{42}i_{t-1} + a_{43}y_{t-1} + a_{44}emp_{t-1} + e_{4t} \tag{5.12}$$

Since $e_t = B^{-1}\varepsilon_t$, we can compute $e_{dc_t}$, $e_{i_t}$, $e_{y_t}$ and $e_{emp_t}$ as:

$$e_t = \frac{Adj.B}{|B|}\varepsilon_t \tag{5.13}$$

OR:

OR:
$$\begin{bmatrix} e_{dc_t} \\ e_{i_t} \\ e_{y_t} \\ e_{emp_t} \end{bmatrix} = \frac{\begin{bmatrix} |c_{11}| & |c_{12}| & |c_{13}| & |c_{14}| \\ |c_{21}| & |c_{22}| & |c_{23}| & |c_{24}| \\ |c_{31}| & |c_{32}| & |c_{33}| & |c_{34}| \\ |c_{41}| & |c_{42}| & |c_{43}| & |c_{44}| \end{bmatrix}}{|B|} \begin{bmatrix} \varepsilon_{dc_t} \\ \varepsilon_{i_t} \\ \varepsilon_{y_t} \\ \varepsilon_{emp_t} \end{bmatrix}$$

Where $|c_{11}|, |c_{12}|.....|c_{14}|$ are cofactors of matrix B.

OR:

$$e_{dc_t} = \frac{|c_{11}|\varepsilon_{dc_t} + |c_{12}|\varepsilon_{i_t} + |c_{13}|\varepsilon_{y_t} + |c_{14}|\varepsilon_{emp_t}}{|B|} \tag{5.14}$$

$$e_{i_t} = \frac{|c_{21}|\varepsilon_{dc_t} + |c_{22}|\varepsilon_{i_t} + |c_{23}|\varepsilon_{y_t} + |c_{24}|\varepsilon_{emp_t}}{|B|} \quad (5.15)$$

$$e_{y_t} = \frac{|c_{31}|\varepsilon_{dc_t} + |c_{32}|\varepsilon_{i_t} + |c_{33}|\varepsilon_{y_t} + |c_{34}|\varepsilon_{emp_t}}{|B|} \quad (5.16)$$

$$e_{emp_t} = \frac{|c_{41}|\varepsilon_{dc_t} + |c_{42}|\varepsilon_{i_t} + |c_{43}|\varepsilon_{y_t} + |c_{44}|\varepsilon_{emp_t}}{|B|} \quad (5.17)$$

**5.3 Vector Moving Average (Impulse Response Function)**

We have discussed in the foregoing section that a VAR system regresses each endogenous variable on its own lags. To ensure that the innovations are white noise, the number of such lags could be numerous. Given the large number of lags involved, individual coefficients in VAR are difficult to interpret. Given the difficulty, Sims' (1980) developed the technique of interpreting the variables of the VAR system in terms of Impulse Response Functions. Generation of IRF's from the estimated VAR system is explained below.

An impulse response function traces the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables. The process of generating IRF's and why these can be used instead of coefficients of variables, for interpretation of the VAR system, is described, below.

According to Enders (1995, p. 305),

> "Just as an autoregression has a moving average representation, a vector autoregression can be written as a vector moving average (VMA).---The VMA representation is an essential element of Sims' (1980) as it allows us to trace the time path of various shocks contained in the VAR system."

The VMA is described below.

In the first order autoregressive model:

$$y_t = a_o + a_1 y_{t-1} + \varepsilon_t \quad (5.18)$$

The stationarity condition is that $a_1$ in equation (5.18) be less than unity in absolute value. There is some similarity between this condition and the matrix $A_1$ in the first-order auto-

regressive model given by (5.8). The system of equations given by (5.9)-(5.12), that in fact is a detailed representation of (5.8), can be written as:

$$dc_t - a_{11}dc_{t-1} = a_{10} + a_{12}i_{t-1} + a_{13}y_{t-1} + a_{14}emp_{t-1} + e_{1t} \quad (5.19)$$

$$i_t - a_{22}i_{t-1} = a_{20} + a_{21}dc_{t-1} + a_{23}y_{t-1} + a_{24}emp_{t-1} + e_{2t} \quad (5.20)$$

$$y_t - a_{33}y_{t-1} = a_{30} + a_{31}dc_{t-1} + a_{32}i_{t-1} + a_{34}emp_{t-1} + e_{3t} \quad (5.21)$$

$$emp_t - a_{44}emp_{t-1} = a_{40} + a_{41}dc_{t-1} + a_{42}i_{t-1} + a_{43}y_{t-1} + e_{4t} \quad (5.22)$$

The backward iteration of the system of equations given above yields:

$$(1 - a_{11}L)dc_t = a_{10} + a_{12}i_{t-1} + a_{13}y_{t-1} + a_{14}emp_{t-1} + e_{1t} \quad (5.23)$$

$$(1 - a_{22}L)i_t = a_{20} + a_{21}dc_{t-1} + a_{23}y_{t-1} + a_{24}emp_{t-1} + e_{2t} \quad (5.24)$$

$$(1 - a_{33}L)y_t = a_{30} + a_{31}dc_{t-1} + a_{32}i_{t-1} + a_{34}emp_{t-1} + e_{3t} \quad (5.25)$$

$$(1 - a_{44}L)emp = a_{40} + a_{41}dc_{t-1} + a_{42}i_{t-1} + a_{43}y_{t-1} + e_{4t} \quad (5.26)$$

OR:

$$dc_t = \frac{a_{10}}{1 - a_{11}L} + \frac{a_{12}}{1 - a_{11}L}i_{t-1} + \frac{a_{13}}{1 - a_{11}L}y_{t-1} + \frac{a_{14}}{1 - a_{11}L}emp_{t-1} + \frac{e_{1t}}{1 - a_{11}L} \quad (5.27)$$

$$i_t = \frac{a_{20}}{1 - a_{22}L} + \frac{a_{21}}{1 - a_{22}L}dc_{t-1} + \frac{a_{23}}{1 - a_{22}L}y_{t-1} + \frac{a_{24}}{1 - a_{22}L}emp_{t-1} + \frac{e_{2t}}{1 - a_{22}L} \quad (5.28)$$

$$y_t = \frac{a_{30}}{1 - a_{33}L} + \frac{a_{31}}{1 - a_{33}L}dc_{t-1} + \frac{a_{32}}{1 - a_{33}L}i_{t-1} + \frac{a_{34}}{1 - a_{33}L}emp_{t-1} + \frac{e_{3t}}{1 - a_{33}L} \quad (5.29)$$

$$emp_t = \frac{a_{40}}{1 - a_{44}L} + \frac{a_{41}}{1 - a_{44}L}dc_{t-1} + \frac{a_{42}}{1 - a_{44}L}i_{t-1} + \frac{a_{43}}{1 - a_{44}L}y_{t-1} + \frac{e_{4t}}{1 - a_{44}L} \quad (5.30)$$

Or we can write the above in matrix form as:

$$M_t = D_o + NM_{t-1} \quad (5.31)$$

Where:

$$M_t = \begin{bmatrix} dc_t \\ i_t \\ y_t \\ emp_t \end{bmatrix}, \quad D_o = \begin{bmatrix} \frac{a_{10}}{1-a_{11}L} \\ \frac{a_{20}}{1-a_{22}L} \\ \frac{a_{30}}{1-a_{33}L} \\ \frac{a_{40}}{1-a_{44}L} \end{bmatrix},$$

$$N = \begin{bmatrix} 0 & \frac{a_{12}}{1-a_{11}L} & \frac{a_{13}}{1-a_{11}L} & \frac{a_{14}}{1-a_{11}L} \\ \frac{a_{21}}{1-a_{22}L} & 0 & \frac{a_{23}}{1-a_{22}L} & \frac{a_{24}}{1-a_{22}L} \\ \frac{a_{31}}{1-a_{33}L} & \frac{a_{32}}{1-a_{33}L} & 0 & \frac{a_{34}}{1-a_{33}L} \\ \frac{a_{41}}{1-a_{44}L} & \frac{a_{42}}{1-a_{44}L} & \frac{a_{43}}{1-a_{44}L} & 0 \end{bmatrix}$$

Stationarity requires that the characteristic roots of:

$|N - \lambda I| = 0$ lie outside the unit circle, where $I$ is 4 x 4 Identity matrix and λ is the characteristic root. The stability condition is that λ <1. On simplification, it yields that the roots of the following lie outside the unit circle:

$$c_4\lambda^4 + c_3\lambda^3 + c_2\lambda^2 + c_1\lambda + c_o = 0$$

Assuming that the stability condition is met, the particular solution for $x_t$ can be written as:

$$x_t = \mu + \sum_{i=0}^{\infty} A_1^i e_{t-i} \qquad (5.32)$$

Where $\mu = \left[\overline{dc_t} \quad \overline{i_t}, \quad \overline{y_t}, \quad \overline{emp_t}\right]$ and:

$$\overline{dc_t} = \frac{\left[a_{10}(1-a_{22})(1-a_{33})(1-a_{44}) - a_{12}a_{20}a_{30}a_{40}\right] - a_{13}a_{20}a_{30}a_{40} - a_{14}a_{20}a_{30}a_{40}}{c_4\lambda^4 + c_3\lambda^3 + c_2\lambda^2 + c_1\lambda + c_o} \qquad (5.33)$$

$$\overline{i_t} = \frac{\left[a_{20}(1-a_{11})(1-a_{33})(1-a_{44}) - a_{21}a_{10}a_{30}a_{40}\right] - a_{23}a_{10}a_{30}a_{40} - a_{24}a_{10}a_{30}a_{40}}{c_4\lambda^4 + c_3\lambda^3 + c_2\lambda^2 + c_1\lambda + c_o} \qquad (5.34)$$

$$\overline{y_t} = \frac{\left[a_{30}(1-a_{11})(1-a_{22})(1-a_{44}) - a_{31}a_{10}a_{20}a_{40}\right] - a_{32}a_{10}a_{20}a_{40} - a_{34}a_{10}a_{20}a_{40}}{c_4\lambda^4 + c_3\lambda^3 + c_2\lambda^2 + c_1\lambda + c_o} \quad (5.35)$$

$$\overline{emp_t} = \frac{\left[a_{40}(1-a_{11})(1-a_{22})(1-a_{33}) - a_{41}a_{10}a_{20}a_{30}\right] - a_{42}a_{10}a_{20}a_{30} - a_{43}a_{10}a_{20}a_{30}}{c_4\lambda^4 + c_3\lambda^3 + c_2\lambda^2 + c_1\lambda + c_o} \quad (5.36)$$

The system of equations given by (5.33)-(5.36) is VMA representation of (5.6) as the variables $[dc_t, i_t, y_t, emp_t]$ are expressed in terms of the current and past values of four type of shocks (i.e. $e_{it}, e_{2t}, e_{3t}$ and $e_{4t}$). To elaborate we express below the standard VAR given by (5.9)-(5.12) in matrix form:

$$\begin{bmatrix} dc_t \\ i_t \\ y_t \\ emp_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \\ a_{30} \\ a_{40} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \begin{bmatrix} dc_{t-1`} \\ i_{t-1`} \\ y_{t-1} \\ emp_{t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \end{bmatrix} \quad (5.37)$$

Or using equation (5.32) we can write:

$$\begin{bmatrix} dc_t \\ i_t \\ y_t \\ emp_t \end{bmatrix} = \begin{bmatrix} \overline{dc_t} \\ \overline{i_t} \\ \overline{y_t} \\ \overline{emp_t} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \begin{bmatrix} e_{1t-i} \\ e_{2t-i} \\ e_{3t-i} \\ e_{4t-i} \end{bmatrix} \quad (5.38)$$

Equation (5.38) expresses $dc_t$ $i_t$ $y_t$ and $emp_t$ in terms of $e_{1_t}$, $e_{2_t}$, $e_{3_t}$ and $e_{4_t}$ respectively. For further insight we rewrite (5.38) in terms of $\{\varepsilon_{dc_t}\}, \{\varepsilon_{i_t}\}, \{\varepsilon_{y_t}\}, and \{\varepsilon_{emp_t}\}$ sequences. From (5.14)-(5.17) the vector of errors can be written as:

$$\begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \end{bmatrix} = \left[\frac{1}{|B|}\right] AdjB \begin{bmatrix} \varepsilon_{dc_t} \\ \varepsilon_{i_t} \\ \varepsilon_{y_t} \\ \varepsilon_{emp_t} \end{bmatrix} \quad (5.39)$$

Equation (5.38) and (5.39) can be combined to yield:

$$\begin{bmatrix} dc_t \\ i_t \\ y_t \\ emp_t \end{bmatrix} = \begin{bmatrix} \overline{dc_t} \\ \overline{i_t} \\ \overline{y_t} \\ \overline{emp_t} \end{bmatrix} + \frac{1}{|B|}\sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} AdjB \begin{bmatrix} \varepsilon_{dc_t-i} \\ \varepsilon_{i_{t-i}} \\ \varepsilon_{y_{t-i}} \\ \varepsilon_{emp_{t-i}} \end{bmatrix} \tag{5.40}$$

To simplify the notations, we define 4 x 4 matrix $\phi_i$ with elements $\phi_{jk}(i)$:

$$\phi_i = \left[ \frac{A_1^i}{|B|} AdjB \right] \tag{5.41}$$

Now the moving average representation of (5.40) and (5.41) can be written in terms of the $\{\varepsilon_{dc_t}\}, \{\varepsilon_{i_t}\}, \{\varepsilon_{y_t}\}, and \{\varepsilon_{emp_t}\}$ sequences.

$$\begin{bmatrix} dc_t \\ i_t \\ y_t \\ emp_t \end{bmatrix} = \begin{bmatrix} \overline{dc_t} \\ \overline{i_t} \\ \overline{y_t} \\ \overline{emp_t} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \phi_{11}(i) & \phi_{12}(i) & \phi_{13}(i) & \phi_{14}(i) \\ \phi_{21}(i) & \phi_{22}(i) & \phi_{23}(i) & \phi_{24}(i) \\ \phi_{31}(i) & \phi_{32}(i) & \phi_{33}(i) & \phi_{34}(i) \\ \phi_{41}(i) & \phi_{42}(i) & \phi_{43}(i) & \phi_{44}(i) \end{bmatrix} \begin{bmatrix} \varepsilon_{dc_{t-i}} \\ \varepsilon_{i_{t-i}} \\ \varepsilon_{y_t-i} \\ \varepsilon_{emp_t-i} \end{bmatrix} \tag{5.42}$$

Or more compactly:

$$x_t = \mu + \sum_{i=0}^{\infty} \phi_i \varepsilon_{t-i} \tag{5.43}$$

The moving average representation given by (5.43) enables us to examine the interaction between $\{\varepsilon_{dc_t}\}, \{\varepsilon_{i_t}\}, \{\varepsilon_{y_t}\}, and \{\varepsilon_{emp_t}\}$ sequences. The coefficients of $\phi_i$ can be used to generate the effect of $\varepsilon_{dc_t}$, $\varepsilon_{i_t}, \varepsilon_{y_t}$ and $\varepsilon_{emp_t}$ shocks on the entire time path of $\{dc_t\}, \{i_t\}, \{y_t\}, and \{emp_t\}$ sequences. The sixteen elements of $\phi_{jk}$ are the impact multipliers. For example $\phi_{14}(0), \phi_{24}(0), and \phi_{34}(0)$ are respectively the instantaneous impact of one unit (standard deviation) change in $\varepsilon_{emp_t}$ on $dc_t, i_t,$ and $y_t$. Similarly, the elements $\phi_{11}(1), \phi_{12}(1), \phi_{13}(1)$ and $\phi_{14}$ are the one period responses of unit changes in $\varepsilon_{dc_{t-1}}$ $\varepsilon_{i_{t-1}}, \varepsilon_{y_{t-1}}$ and $\varepsilon_{emp_{t-1}}$ on $dc_t$. Updating by one period indicates that $\phi_{11}(1), \phi_{12}(1), \phi_{13}(1)$ and $\phi_{14}(1)$ also represent the effects of unit changes in $\varepsilon_{dc_t}$ $\varepsilon_{i_t}, \varepsilon_{y_t}$ and $\varepsilon_{emp_t}$ on $dc_{t+1}$.

Now incorporating the exogenous variables into the system yields the following VAR system:

$$q_t = a_0 + \sum_{J=1}^{P} A_j q_{t-j} + \delta z_t + \lambda \pi_t^* + e_t \tag{5.44}$$

Where $q_t = dc_t, emp_t, y_t, i_t$ , $A_j$ is vector of coefficients of the endogenous variables, δ and λ represent the coefficients of the two exogenous variables: $z_t$ and $\pi_t^*$ and $e_t = e_{dc_t}$ , $e_{i_t}\ e_{y_t}\ e_{emp_t}$ is a vector of innovation. Each element of the innovation vector $e_t$ is in turn composed of own error terms $w_t$ and contemporaneous correlation, based on assumed *Ordering*, with other innovation ( $\beta_{i's}$ )

5.4 **Identification of IRF's: Choleski decomposition:**

An estimated (standard) VAR system as given by equation (5.9) to equation (5.12) is under identified because estimation of the system yields 30 coefficient estimates However the structural VAR given by the system from equation (5.2) to equation (5.5) contains 36 parameters.[15] Therefore we must impose six restrictions on the on the four variable Structural VAR to identify the IRF's. Choleski decomposition is one of the possible identification restrictions. The decomposition restricts the system in such a manner that the contemporaneous value of one of the variable does not exercise contemporaneous influence upon another variable but not vice versa. The decomposition calls for an *a priori* representation of the contemporaneous correlation among individual components of $e_t$. The required *a priori* representation is achieved by assigning an *Ordering* to the endogenous variables included in the VAR system. For the VAR system given by (5.6), the *ordering,* of variables assumed is: [$dc_t$ $i_t$ $y_t$ $emp_t$]. To identify the structural model given by equation (5.2) to equation (5.5), it is necessary to impose $((n^2 - n)/2$ restrictions on the structural model. This in turn requires that all the elements

[15] The 30 Parameter estimates from standard VAR system include: 20 coefficient estimates $a_{10}, a_{20}, a_{30}, a_{40}, a_{11}, a_{12}, a_{13}, a_{14}, a_{21}, a_{22}, a_{23,} a_{24}, a_{31}, a_{32}, a_{33}, a_{34}, a_{41}, a_{42}, a_{43}, a_{44}$, and the calculated values of $\text{var}(e_{1t}), \text{var}(e_{2t}), \text{var}(e_{3t}), \text{var}(e_{4t}), \text{cov}(e_{1t}e_{2t}e_{3t}e_{4t}), \text{cov}(e_{2t}e_{3t}e_{4t})\text{cov}(e_{3t}e_{4t})$ The 36 parameters in the structural system include: Four intercept coefficients $b_{10}, b_{20}, b_{30}, b_{40}$ 12 feedback coefficients $b_{12}, b_{13}, b_{14}, b_{21}, b_{23}, b_{24}, b_{31}, b_{32}, b_{34}, b_{41}, b_{42}, b_{43}$ 16 autoregressive coefficients $\gamma_{11}, \gamma_{12}, \gamma_{13}, \gamma_{14}, \gamma_{21}, \gamma_{22}, \gamma_{23}, \gamma_{24}, \gamma_{31}, \gamma_{32}, \gamma_{33}, \gamma_{34}, \gamma_{41}, \gamma_{42}, \gamma_{43}, \gamma_{44}$ and four standard deviations $\sigma_{dc_t}, \sigma_{i_t}, \sigma_{y_t}, \sigma_{emp_t}$

above the principle diagonal in (5.7) be zero (Enders, 1995, pp.323-24). This has the effect of setting the following coefficients, in equation (5.7) equivalent to zero:

$$b_{12} = b_{13} = b_{14} = 0$$
$$b_{23} = b_{24} = 0$$
$$b_{34} = 0$$

For the VAR system given by equation (5.44), the *ordering,* of variables assumed is: [$dc_t$ $i_t$ $y_t$ $emp_t$] . The assumed *ordering* has the effect of generating the following:

$$e_{dc_t} = w_{dc_t} + \beta_{dc_t.i_t} w_{i_t} + \beta_{dc_t.y_t} w_{y_t} + \beta_{dc_t.emp_t} w_{emp_t} \quad (5.45)$$

$$e_{i_t} = \beta_{i_t.dc_t} w_{dc_t} + w_{i_t} + \beta_{i_t.y_t} w_{y_t} + \beta_{i_t.emp_t} w_{emp_t} \quad (5.46)$$

$$e_{y_t} = \beta_{y_t.dc_t} w_{dc_t} + \beta_{y_t.i_t} w_{y_t} + w_{y_t} + \beta_{y_t.emp_t} w_{emp_t} \quad (5.47)$$

$$e_{emp_t} = \beta_{emp_t.dc_t} w_{dc_t} + \beta_{emp_t.i_t} w_{i_t} + \beta_{emp_t.y_t} w_{emp_t} + w_{emp_t} \quad (5.48)$$

Where the structural disturbances $w$ and $\beta$ coefficients provide a compact way of rewriting the contemporaneous terms of the moving average representation of the structural VAR given by equation (5.14) to equation (5.17).

To give effect to the assumed *ordering*:

$\beta_{dc_t.i_t}$ , $\beta_{dc_t.y_t}$ and $\beta_{dc_t.emp_t}$ from equation (5.45), $\beta_{i_t.y_t}$ and $\beta_{i_t.emp_t}$ from equation (5.46) and $\beta_{y_t.emp_t}$ from equation (5.47) are set equal to zero.

After setting the above referred coefficients to zero (in accordance with the requirement of *Choleski* decomposition), equation (5.45) to (5.48) reflect the following contemporaneous relationship among the variables.

- Innovation to domestic credit ($e_{dc_t}$) is a function of own contemporaneous innovation($w_{dc_t}$) only. But the innovation to domestic credit influences innovations to all endogenous variables. Notice that ($w_{dc_t}$) appears in all the equations from (5.45) to (5.48). It's also worth noting, in these equations, that the coefficients

attached to ( $w_{dc_t}$ ) are not the ones that have been set equal to zero. Innovations to other variables having been set equal to zero do not exercise contemporaneous influence upon innovation to domestic credit. (eq. 5.45)

- In accordance with the pattern outlined above, innovation to interest rate ( $e_{i_t}$ ) is a function of own innovation ( $w_{i_t}$ ), and contemporaneous innovations to domestic credit ( $\beta_{i_t.dc_t} w_{dc_t}$ ). Here innovations to real income and exchange market pressure, having been set equal to zero, do not exercise contemporaneous influence on innovation to interest rate. (eq. 5.46)
- Similarly, innovation to real income ( $e_{y_t}$ ) is a function of own innovation ( $w_{y_t}$ ) and contemporaneous innovations to domestic credit ( $\beta_{y_t.dc_t} w_{dc_t}$ ), and interest rate ( $\beta_{i_t.y_t} w_{y_t}$ ) (eq. 5.47)
- Finally innovation to exchange market pressure ( $e_{emp_t}$ ) is a function of own innovation ( $w_{emp_t}$ ) and contemporaneous innovations to all other endogenous variables that is, domestic credit ( $\beta_{emp_t.dc_t} w_{dc_t}$ ), interest rate ( $\beta_{emp_t.i_t} w_{emp_t}$ ) and real income ( $\beta_{emp_t.y_t} w_{emp_t}$ ). (eq. 5.48)

In sum, at one extreme is domestic credit that contemporaneously affects innovation to remaining three endogenous variables of the system but, itself is contemporaneously influenced by own innovation only while at other extreme is exchange market pressure that is contemporaneously influenced by innovations to all the four (including itself), endogenous variables of the system but itself does not contemporaneously influence innovation to any variable of the system. It is important to note here that the foregoing representation only reflects the contemporaneous relationship among the endogenous variables. As far as the lagged response to innovations is concerned, innovations to all the variables influence other variables with a lag.

The representation (*ordering*) outlined above is only the most preferable one and certainly not the final word. Given that the results could be sensitive to *ordering* of variables, sensitivity of the results to following alternate o*rderings* will be tested.

1) $[dc_t \ i_t \ emp_t \ y_t]$
2) $[dc_t \ emp_t \ i_t \ y_t]$
3) $[dc_t \ emp_t \ i_t \ y_t]$
4) $[emp_t \ dc_t \ i_t \ y_t]$,

### 5.4.1 Economic rationale for the assumed *ordering* and possible alternate *orderings* under alternative assumptions

The representation outlined above implicitly assumes an exogeneity ranking (*ordering*) of policy tools. One of the criticisms of VAR technique is that *ordering* assigned to variables is quite often arbitrary and hence a-theoretic. To account for this criticism effort should be made to base the *ordering* upon sound economic rationale. Before we discuss the rationale for our assumed *ordering* we may caution that given the simultaneity among variables, it is possible to have two opinions for quite a few possible *orderings* if not for all possible *orderings*. It is precisely for this reason that the study aims to look at sensitiveness of the results to some alternate possible *orderings* as well. Economic rationale for assumed *ordering*: $[dc_t \ i_t \ y_t \ emp_t]$ discussed below needs to be viewed in this context.

Domestic credit is a policy variable over which the authority enjoys complete control. Hence in the above system ($e_{dc_t}$) is only a function of its own contemporaneous innovation. That is, it is not influenced contemporaneously by innovation to other variables. Rather, being a policy variable and under full control of the monetary authorities it exercises contemporaneous influence upon all variables of the system.

As the interest rate besides being influenced by the authority has a market determined element as well therefore it is of lower exogeneity level relative to domestic credit. This is reflected in the system of equations (eq.5.45-5.48) outlined above as innovation to interest rate besides being function of its own innovation is also a function of contemporaneous innovations to, domestic credit.

Real income is known to be influenced by monetary policy, therefore innovation to real income besides being a function of own contemporaneous innovation is also assumed to be a function of innovation to domestic credit and interest rate.

Finally, under monetary theory, money supply is known to exercise influence upon exchange market pressure, comprising change in reserve and change in exchange rate. Interest rate changes too may influence exchange market pressure via change in money demand or via change in level of capital flows. Similarly the level of real income influences the level of imports/exports that in turn exercise influence on exchange market pressure. Hence the lowest exogeneity ranking of exchange market pressure.

### 5.5 **Hypotheses**:

Our hypotheses of interest are extracted from equation (5.48). These are:

- $\beta_{emp_t.dc_t} w_{dc_t} > 0$ and,
- $\beta_{emp_t.i_t} w_{i_t} > 0$

The first one implies that shock to innovation to domestic credit has a positive impact upon exchange market pressure while the second one says that impact of shock to innovation to interest rate upon exchange market pressure is positive. The discussion on theoretical foundations of the hypotheses follows.

#### 5.5.1 **Domestic credit: Positive Relationship with *emp***

Positive influence of shock to innovation to domestic credit upon exchange market pressure stems from monetary approach: According to monetary approach to BOP, payment imbalances reflect stock disequilibria between money supply and money demand. The approach views BOP as a safety valve that opens up automatically to either release an excess supply of money in the form of BOP deficit or allow into the country an additional amount of money in the form of BOP surplus in order to satisfy an existing excess demand for money. The outflow/inflow money takes place by way of international trade in goods and services or market for international securities. If the free float exchange rate regime is being practiced then the adjustment burden of stock disequilibria in money market falls on exchange rate rather then foreign reserves. In case of managed float the adjustment burden is shared between foreign reserves and exchange rate. The monetary authority, consciously determines the adjustment proportion.

Given the foregoing, an increase in domestic credit is offset by exchange rate depreciation or foreign reserves outflow or some combination of the two, that is, increase in exchange market pressure. Hence the positive impact of change in domestic credit upon exchange market pressure.

### 5.5.2 **Interest Rate: Positive Relationship with *emp***

The theoretical foundation for the relationship between shock to innovation to interest rate and exchange market pressure is drawn from the theory of money demand and interest rate parity theory.

According to Keynesian theory of money demand interest rate bears negative relationship with money demand. Thus a positive shock to interest rate would reduce money demand. Given money supply, the reduction in money demand disturbs the monetary equilibrium. To restore the equilibrium the exchange rate depreciates or foreign reserves deplete there by causing exchange market pressure. Thus the influence of interest rate on exchange market pressure is positive.

The relationship between interest rate and exchange market pressure can also be traced to interest rate parity theory. Popularized as uncovered interest parity (UIP) condition, essence of the theory is that, the expected rate of depreciation of domestic currency is equal to the interest rate differential between domestic and foreign interest rates. In other words given foreign interest rate, an increase in domestic interest rate will lead to depreciation of domestic currency, implying an increase in exchange market pressure. Hence the positive influence of interest rate upon exchange market pressure as reflected in our exchange market pressure model given by equation (4.21)

# 6 Data & Statistical Tests

This chapter describes the data used the econometric tests employed to check the appropriateness of the data for econometric investigation and presents the results of the tests used.

## 6.1 The Data

The variables included in empirical model given by equation (5.44) are: Exchange Market Pressure ($emp_t$), Domestic Credit ($dc_t$), Interest rate [T-bill rate: ($i_t$)], Real income [Proxy: Industrial production ($y_t$)], International inflation [Proxy: U.S. inflation ($\pi^*_t$)] and Deviation from purchasing power parity ($z_t$). Here it is note worthy that the industrial production in Pakistan, from 1999-00 to 2005-06, has on average comprised only 25 percent of GDP and the average inflation rate for the world may significantly diverge from the U.S. inflation rate that has been around 2.5 percent between 1982-2005. Given these facts we would like to caution the reader that industrial production and U.S. inflation may not be entirely satisfactory proxies for real income and world inflation however we use these proxies because these constitute the best ones for which the data is available, at monthly frequency[16].

Of the six variables mentioned above data for the series' $i_t$, $y_t$ and $\pi^*_t$ are directly available in published statistics while data for the series $dc_t$, $emp_t$ and $z_t$ is to be generated. This in turn requires data on some more variables. The variables required for generation of these series are discussed below.

### 6.1.1 Domestic credit

Reserve Money being composed of domestic and foreign components, the domestic credit is worked out as the difference between total Reserve Money and the foreign component of Reserve Money. The foreign component is obtained by multiplying the month-end foreign reserves outstanding with the relevant month-end nominal exchange rate. To work out the Domestic Credit in the manner referred above, we need data on the following series.

- Reserve Money
- Foreign Reserves
- Nominal Exchange rate

### 6.1.2 Exchange Market Pressure

Exchange market pressure ($emp_t$), being defined as sum of exchange rate depreciation and foreign reserves outflow scaled by monetary base (Reserve money) requires data on the following:

- Nominal exchange rate
- Foreign Reserves
- Reserve Money

The data required for generating the Exchange market pressure series is exactly the same as required for generating domestic credit series.

### 6.1.3 Deviation from Purchasing Power Parity

As explained earlier under theoretical framework (Chapter 5) deviation from purchasing power parity (PPP) is to be worked out as per equation (4.16) which after slight algebraic manipulation is reproduced below for ready reference.

$$z_t = e_t + \pi_t^* - \pi_t \qquad (4.16)$$

To generate the series 'Deviation from PPP' ($z_t$) we need data on the following:

- Nominal exchange rate
- International price level (Proxy: US CPI)
- Domestic price level (CPI)

## 6.2 Data-Sources

Given the above, in all, data for the following series is required. The data has been obtained from International Financial Statistics (IFS) CD-ROM (May 2006). The exact reference is given below.

| Variable: | IFS: Pakistan Page Line # |
|---|---|
| Exchange Rate | ae |
| Foreign Reserves | 1 L.D |
| Reserve Money | 14 |
| Interest rate (T-bill rate)*: | 60C |
| Real income (Proxy: Manufacturing production): | 66EY |
| International inflation (π*): [Proxy: US-CPI] | 64 (US page) |
| Domestic price level (CPI) | 64 |

[16] Justification for the use of data with frequency is given in section 6.4.

### 6.3 Data Span

Data span of this study is: 1982:01-2005:12. The motivation for the span is that the exchange market pressure model is particularly applicable to managed float (though it is possible to use the model for other exchange rate regimes as well). Till January 7, 1982 Pak Rupee was pegged to Dollar. On January 8, 1982 Pakistan adopted managed float. Hence a logical starting point of the data span is January 1982.

However it is important to mention that the span: 1982:01-2005:12 is used for determining the degree Monetary Autonomy only, that requires data on two series viz. exchange market pressure ($emp_t$) and foreign reserves ($r_t$). The span used for estimation of the empirical model given by (5.44) is 1991:04-2005:12. The motivation for selection of the rather small sample, spanning over 14.9 years, is that we want to determine whether the dominant tool of monetary policy vis-à-vis exchange market pressure is interest rate or domestic credit. Prior to March 91 interest rate was regulated by SBP. Interest rate on Government Treasury Depository Receipts (GTDRs), whose features are similar to that of Treasury Bills in vogue now, was changed only once during the eight years preceding March 1991. This is enough to conclude that interest rate was not being used as an instrument of monetary policy prior to 1991. Therefore, given our objective, referred above, we cannot include the data prior to 1991. Hence the small sample that we have. Besides we use sub-spans spanning over nine, seven and five and a half years. (Motivation for the sub-spans used is discussed at length in Chapter 9).

### 6.4 Data Frequency:

Data frequency is monthly. The motivation for using high frequency data is that the data includes monetary variables besides the exchange rate and foreign reserves. These variables have dynamic properties that can be best captured with high frequency data. We may add here that given the dynamic properties of domestic credit and interest rate, the causal *ordering* [$dc_t$ $i_t$ $y_t$ $emp_t$] assumed[17] for estimation of the VAR system given by equation (5.44) makes more sense and is more defensible with monthly rather than quarterly or annual data. Finally, as mentioned above, we have a relatively small sample of 14.9 years. Given the sample, to provide the degrees of freedom, sufficient

[17] Economic rationale for the assumed ordering has been discussed in section 5.4.1.

enough for reliable econometric investigation, the use of annual data is ruled out. Similarly, the use of sub-spans, referred above, rule out the use of even quarterly data.

## 6.5 Statistical Tests

This section tests whether the data series used are appropriate for econometric investigation. The tests used to check for serial correlation and stationarity are described besides the results of the tests are also presented.

### 6.5.1 **Serial Correlation**[18]

The classical linear regression model assumes the absence of serial correlation in the disturbances term $\mu_i$, Symbolically:

$$E(\mu_i\mu_j) = 0 \qquad i \text{ not equal to } j$$

In plain words, the classical model assumes that the disturbance term relating to any observation is not influenced by the disturbance term relating to any other observation. Therefore it is important to ensure that the disturbance term arising from a regression is free of serial correlation.

One of the popular tests that checks for the absence of serial correlation is the Breusch-Godfrey (BG) test of higher-order serial correlation. BG test, being a popular one, is used in this study to ensure that the disturbance terms, wherever these occur, are free of serial correlation. It is in this context that the test is described below.

Suppose we have estimated the following regression:

$$y_t = x_t b + u_t \qquad (6.1)$$

Where $x_t$ is a vector of variables and $u_t$ are the residuals. Further assume that the disturbance term $u_t$ is generated by the following *pth* order autoregressive scheme:

$$u_t = \alpha_1 u_{t-1} + \alpha_2 u_{t-2} + ....\alpha_p \mu_{t-p} + \varepsilon_i \qquad (6.2)$$

Where $\varepsilon_i$ is a purely random disturbance term with zero mean and constant variance.

We want to test the Null Hypothesis: $\alpha_1 = \alpha_2 = .... = \alpha_p = 0$. This implies testing that all the autoregressive coefficients are simultaneously zero, that is, there is no autocorrelation of any order. Breusch and Godfrey (BG) have shown that the above-referred Null can be tested as follows:

[18] Exposition of the test is based on Gujrati (1998), pp.425-6.

a)Estimate the regression model by the usual OLS procedure and obtain the estimated residuals.

b)Regress the estimated residuals against all regressors in the original regression plus lagged values of estimated residuals i.e. run an auxiliary regression of the following form:

$$\varepsilon_t = x_t\gamma + \alpha_1 \hat{u}_{t-1} + \alpha_2 \hat{u}_{t-2} + ....\alpha_p \hat{u}_{t-p} + v_t \qquad (6.3)$$

where ^ over residuals to indicates their estimated nature.

Breusch and Godfrey have shown that asymptotically, ($n$-$p$) times $R^2$ obtained from auxiliary regression follows chi-square distribution with $p$ degrees of freedom. Where $n$ is the number of observations and $p$ is the lag order of estimated residuals.

If in an application ($n$-$p$).$R^2$ is less than the critical chi-square value at the chosen level of significance, we fail to reject the null hypothesis referred above which implies that the residual are serially uncorrelated.

An advantage that the BG test enjoys over the Durbin Watson test of autocorrelation is that BG allows for the presence of lag dependent variables on R.H.S. of the equation. On the other hand a limitation of the BG test is that the value of $p$, the lag length of estimated residual, in auxiliary regression, cannot be specified *a priori*. Some experimentation with the value of $p$ is inevitable.

## 6.6 **Stationarity**[19]

A stochastic process is said to be (weakly or covariance) stationary if its mean and variance are constant and the value of the covariance between two time periods depends only on the lag between the two time periods and not on the actual time at which the covariance is computed.[20]

The assumptions of the classical linear regression model require that the data series' containing the variables included in the model should be stationary. In presence of non-stationary variables, there might be spurious regression. A spurious regression according to Granger and Newbold (1974) has a high $R^2$, t-statistics that appear to be significant, but the results are without any economic meaning. Thus standard inference

[19] The discussion is mainly based on Enders (1995), pp.221-225

[20] The definition is from Gujrati (1995).

procedures do not apply to non-stationary series. Therefore, it is important to determine weather a series is stationary or not before using it in a regression.

Formally, if $y_t$ is a stochastic (white noise) time series, it is stationary if it has the following properties.

Mean: $E(y_t) = \mu$

Variance: $var(y_t) = E(y_t - \mu)^2 = \sigma^2$

Covariance $\gamma_k = E(y_t - \mu)(y_{t+k} - \mu)$

In simple terms for a series to be stationary; it's mean, variance and autocovariance (at various lags) should remain constant, no matter at what time we measure them.

Dickey Fuller test, being a popular one, is used in this study to test the data series' for stationarity. Additionally, the data being monthly, Beaulieu and Miron (1993) test for seasonal unit roots is also employed. The two tests are described below in the referred order.

### 6.6.1 Dickey Fuller Test for Unit Root

To understand the test, consider the following model:

$$y_t = \rho y_{t-1} + \varepsilon_t \qquad (6.4)$$

Where $\varepsilon_t$ is the stochastic error term, that has zero mean, constant variance and is non-autocorrelated i.e. $\varepsilon_t$ is a white noise error term.

Subtracting $y_t$ from both sides of equation (7.4) yields:

$$y_t - y_{t-1} = \rho y_{t-1} - y_{t-1} + \varepsilon_t$$

or $$\Lambda y_t = (\rho - 1) y_{t-1} + \varepsilon_t$$

$$= \delta y_{t-1} + \varepsilon_t \qquad (6.5)$$

Where $\delta = (\rho - 1)$ and $\Lambda$ is the first difference operator.

To determine whether a series $y_t$ is non-stationary we can either run the regression (6.4) and see if $\rho$ is statistically equal to 1 or alternatively run the regression (6.5) and see if $\gamma$ is statistically equal to zero, on the basis of t-statistic.(The null in each case is of non-stationarity). Under the null that $\rho = 1$ or $\gamma = 0$ the conventionally computed t-statistic is

known as τ(*tau*). The critical values for *tau* statistic have been computed by Dickey and Fuller on the basis of Monte Carlo simulations. The Dickey Fuller critical values are not completely adequate and these have been considerably extended by MacKinnon through Monte Carlo simulations.

Dickey and Fuller (1979) actually consider the following three different regression equations that can be used to test for the presence of unit root.

$$\Lambda y_t = \gamma y_{t-1} + \varepsilon_t \tag{6.6}$$

$$\Lambda y_t = a_0 + \gamma y_{t-1} + \varepsilon_t \tag{6.7}$$

$$\Lambda y_t = a_0 + a_2 t + \gamma y_{t-1} + \varepsilon_t \tag{6.8}$$

The presence of deterministic elements; $a_0$ $a_2 t$ differentiates (6.6), (6.7) and (6.8). Equation (6.6) reflects a pure random walk model, (6.7) incorporates drift ($a_0$) and (6.8) includes drift besides a linear time trend ($a_2 t$).

The parameter of interest in all the three regression equations is γ. If γ = 0, the $\{y_t\}$ sequence contains a unit root (i.e. the series is non-stationary). The test involves estimating one (or more) of the above mentioned equations, using OLS, to obtain the estimated value of γ and associated standard error and comparing the resulting t-statistic with the appropriate critical value. Mackinnon critical values allow us to determine whether to accept or reject the null hypothesis of γ = 0 (non-stationarity). The methodology is exactly the same no matter which one of the three equations is estimated, however the critical values for t-statistic do depend on whether an intercept (drift) and/or time trend is included.

Its worthwhile to note that all the three equations given above reflect a first order autoregressive process, however if the error term in above referred equations is autocorrelated then the equations are augmented with lag dependent variables on the right hand side i.e. a higher order autoregressive process is used. It can be shown that it is possible to use Dickey-Fuller test for higher-order autoregressive processes as well. Consider the following process:

$$\Lambda y_t = a_0 + a_2 t + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \tag{6.9}$$

The null hypothesis is still that δ =0 that is a unit root exists in $y_t$. When Dickey-Fuller test is applied to models like (6.9) the test is called Augmented Dickey-Fuller test.

### 6.6.2 Result: Dickey-Fuller Test

All the data series have been tested for non-stationarity i.e. unit root. The test employed is Dickey Fuller/ Augumented Dickey Fuller. Specifically, the test regression given by (6.8) has been used.

Once the regression is run the first step is to check the residuals for serial correlation. If the residuals do exhibit serial correlation, lag dependent variables are introduced on R.H.S. Introduction of Lag dependent variables imply the use of Augmented Dickey Fuller test. The lags of dependent variable indicated in the table 6.1 have been introduced in the said context. The table also contains the results of Dickey-Fuller test.

Table: 6.1
Results: Dickey-Fuller Unit Root test

| | Determ -inistic | Lags of Dependent Variable | LM test Statistic | δ : t-value | Status of Null: δ = 0 |
|---|---|---|---|---|---|
| $dc_t$ | c, sd | 5 | 16.58 | -4.63 | Rejected |
| $i_t$ | c, sd | - | 14.88 | -10.76 | `` |
| $y_t$ | c, sd | 4 | 17.04 | -7.91 | `` |
| $emp_t$ | c, sd | 1 | 18.63 | -7.57 | `` |
| $z_t$ | c, sd | - | 10.33 | -13.31 | `` |
| $\pi^*$ | c, sd | 8 | 20.86 | -4.54 | `` |

Notes:
Critical value for BG LM test at 5 percent significance level: 21.03
MacKinnon critical value for rejection of Unit Root hypothesis at
5 percent significance level: -3.42
c =Constant, and sd = Seasonal Dummies

Computed LM test statistic being less than critical value (21.03) at 5 percent significance level, we conclude that residuals of the test regression for all the series do not exhibit serial correlation.

The next step is to compare the computed t-value, of coefficient of $y_t$ (-1) i.e. $\delta$ with appropriate Mackinon critical value. If the computed t-value exceed the Mackinon critical value (with negative sign) than this implies the absence of unit root i.e. the series

is stationary. As the computed t-values for all the series exceed the Mackinon critical values, therefore we conclude that all the series' are stationary.

### 6.6.3 Seasonal Unit Roots

The order of integration of a series is commonly determined using an Augmented Dickey-Fuller test (Dickey and Fuller, 1981; Said and Dickey, 1984). But many macroeconomic time series contain important seasonal components. Despite the importance of seasonal movements as a feature of economic data, seasonality has received relatively little attention in the context of seasonal unit roots. A time series, contains seasonal components when there are systematic patterns in the series at the measured points (i.e. seasons) within the year. This may be due to changes in behaviour of agents involved in decision making. These systematic changes may or may not be regular due to different factors like technology, politics, etc. Nelson and Plosser (1982) presented evidence that most economic time series data do contain important stochastic trend components.

More recently, considerable attention has been devoted to detect the presence of unit roots at seasonal frequencies as well as the zero frequency. Dickey, Haza and Fuller (1984) [henceforth DHF] developed a regression-based procedure for testing a unit root at a seasonal lag. However, *DHF* (1984) tests, jointly, for roots at zero and seasonal frequencies and therefore does not allow for unit roots at some, but not all seasonal frequencies.

The limitation of DHF (1981) is overcome by Hylleberg, Engle, Granger and Yoo (1990) [henceforth HEGY] for testing the presence or otherwise of seasonal unit root in quarterly data. The HEGY procedure allows for testing unit roots at each frequency separately, without maintaining the assumption that unit roots are present at some or all of the other frequencies.

HEGY (1990) test for seasonal unit roots is restricted to quarterly data. Beaulieu and Miron [Henceforth BM] (1993) extends the mechanics of HEGY to develop test for determining the presence or otherwise of seasonal unit root in monthly data. They use Monte Carlo methods to compute the finite sample critical values of the test statistics, to test for seasonal unit root in monthly data. As our data frequency is monthly therefore

we will use BM (1993) to test for seasonal unit roots. BM (1993) derivation is reproduced below:

Let $x_t$ be the series of interest generated by general autoregression of the form:

$$\varphi(B)x_t = \varepsilon_t \qquad (6.10)$$

Where $\varphi(B)$ is a polynomial in the backshift operator and $\varepsilon_t$ is a white noise process. Let $\gamma_k$ be the characteristic polynomial associated with $\varphi(B)$ . For the moment assume that deterministic terms, such as seasonal dummies or time trends, are absent from the process for $x_t$ .In general some or all of the $\gamma_k$ may be complex.

The frequency associated with a particular root is the value of $\alpha$ in $e^{\alpha i}$, the polar representation of the root. A root is seasonal if $\alpha = 2\pi j / S,\ j = 1,\text{----},\ S-1$, where S is the number of observations per year. For monthly data the seasonal unit roots are:

$$-1;\ \pm i;\ -\tfrac{1}{2}(1 \pm \sqrt{3}\, i);\ \tfrac{1}{2}(1 \pm \sqrt{3}\, i);\ -\tfrac{1}{2}(\sqrt{3} \pm 1);\ \tfrac{1}{2}(\sqrt{3} \pm 1) \qquad (6.11)$$

with these roots corresponding to 6, 3, 9, 8, 4, 2, 10, 7, 5, 1, and 11 cycles per year respectively. The frequencies of these roots are $\pi, \pm\pi/2, \mp 2\pi/3, \pm\pi/3, \mp 5\pi/6$ and $\pm\pi/6$ respectively. We want to know whether the polynomial in the backshift operator, $\varphi(B)$, has roots equal to one in absolute value at the zero or seasonal frequencies. Specifically the objective is to test the hypothesis about a particular unit root without taking a stand on whether other seasonal or zero frequency unit roots are present.

The testing procedure developed by HEGY consists essentially of linearizing the polynomial $\varphi(B)$ around the zero frequency unit root plus the S-1 unit roots given in (7.11). Thus we can write $\varphi(B)$ as:

$$\varphi(B) = \sum_{K=1}^{S} \lambda_k \Delta(B) \frac{1-\delta_k(B)}{\delta_k(B)} + \Delta(B)\varphi^*(B) \qquad (6.12)$$

Where

$$\delta_k(B) = 1 - \frac{1}{\theta_k}(B), \qquad \lambda_k = \frac{\varphi(\theta_k)}{\prod_{j=k} \delta_j(\theta_k)}, \qquad \Delta(B) = \prod_{k=1}^{s} \delta_k(B)$$

$\varphi(B)^*$ is a remainder with roots outside the unit circle and the $\theta_i$ are the zero frequency unit roots plus the S – 1 seasonal unit roots. In case of monthly data substitution of (6.12) into (7.10) yields:

$$\varphi(B) * y_{13t} = \sum_{k=1}^{12} \pi_{k,t-1} + \varepsilon_t \qquad (6.13)$$

Were

$y_{1t} = (1 + B + B^2 + B^3 + B^4 + B^5 + B^6 + B^7 + B^8 + B^9 + B^{10} + B^{11})\, x_t$,

$y_{2t} = -(1 - B + B^2 - B^3 + B^4 - B^5 + B^6 - B^7 + B^8 - B^9 + B^{10} - B^{11})\, x_t$,

$y_{3t} = -(B - B^3 + B^5 - B^7 + B^9 - B^{11})\, x_t$,

$y_{4t} = -(1 - B^2 + B^4 - B^6 + B^8 - B^{10})\, x_t$,

$y_{5t} = -\frac{1}{2}(1 + B - 2B^2 + B^3 + B^4 - 2B^5 + B^6 + B^7 - 2B^8 + B^9 + B^{10} - 2B^{11})\, x_t$,

$y_{6t} = \frac{\sqrt{3}}{2}(1 - B + B^3 - B^4 + B^6 - B^7 + B^9 - B^{10})\, x_t$,,

$y_{7t} = \frac{1}{2}(1 - B - 2B^2 - B^3 + B^4 + 2B^5 + B^6 - B^7 - 2B^8 - B^9 + B^{10} + 2B^{11})\, x_t$,

$y_{8t} = -\frac{\sqrt{3}}{2}(1 + B - B^3 - B^4 + B^6 + B^7 - B^9 - B^{10})\, x_t$,

$y_{9t} = -\frac{1}{2}(\sqrt{3} - B + B^3 - \sqrt{3}B^4 + 2B^5 - \sqrt{3}B^6 + B^7 - B^9 + \sqrt{3}B^{10} - 2B^{11})\, x_t$,

$y_{10t} = \frac{1}{2}(1 - \sqrt{3}B + 2B^2 - \sqrt{3}B^3 + B^4 - B^6 + \sqrt{3}B^7 - 2B^8 + \sqrt{3}B^9 - B^{10})\, x_t$,

$y_{11t} = \frac{1}{2}(\sqrt{3} + B - B^3 - \sqrt{3}B^4 - 2B^5 - \sqrt{3}B^6 - B^7 + B^9 + \sqrt{3}B^{10} + 2B^{11})\, x_t$,

$y_{12t} = -\frac{1}{2}(1 + \sqrt{3}B + 2B^2 + \sqrt{3}B^3 + B^4 - B^6 - \sqrt{3}B^7 - 2B^8 - \sqrt{3}B^9 - B^{10})\, x_t$,

$y_{13t} = (1 - B^{12})\, x_t$. (6.14)

To test hypothesis about various unit roots, we estimate (6.13) by OLS and than compare the OLS test statistics with the appropriate critical values developed by BM (1993). For frequencies zero and $\pi$, one simply examines the relevant *t*-statistic for $\pi_k = 0$. If the tabulated *t* exceeds the critical *t*, we fail to reject the hypothesis of no unit root at frequency zero and $\pi$. To test for seasonal roots one tests $\pi_{k-1} = \pi_k = 0$. To show that no unit root exists at any seasonal frequency $\pi_k$ must not equal zero for k = 2 and for at least one member of each set {3,4}, {5,6}, {7,8}, {9,10}, {11, 12}. If the calculated F-statistic, for the hypothesis that $\pi_3 = \pi_4 = 0$, exceeds the critical F [worked out by BM (1993)], we fail to reject the hypothesis of no seasonal unit root at frequency $\pi_3$ & $\pi_4$. Similarly, we can test for seasonal unit roots, at other higher frequencies.

The hypothesis tests are amendable for the case where the alternative may include; constant, seasonal dummies, and/or time trend. Equation (6.13) becomes:

$$\varphi(B)^* y_{13t} = \sum_{k=1}^{12} \pi_k y_{k,t-1} + m_0 t + m_1 + \sum_{k=2}^{12} m_k s_{kt} + \varepsilon_t \qquad (6.15)$$

The equation is still estimated by OLS but the asymptotic and finite sample distribution changes.

### 6.6.4 Results: Seasonal Unit Root

Test results for all the data series at zero and seasonal frequencies using, Baeulieu and Miron (1993) have been generated. Initially, the test regression has been estimated by incorporating the deterministic variables: intercept, seasonal dummies and linear time trend. If the time trend happens to be insignificant then it is excluded and the regression is re-estimated. Now the insignificant seasonal dummies are excluded and the remaining regression is re-estimated. If all seasonal dummies are insignificant the regression includes only the intercept as the deterministic term.

Before looking at results for seasonal unit roots, the residuals, of the regressions estimated to test for seasonal unit root, have been tested for serial correlation, using BG LM test. The test results are presented in Table 6.2 (column 3). As the computed chi-square for all the regressions, used for testing seasonal unit root, are less than the critical values (column 3, Table 6.2), therefore we conclude that the residuals do not exhibit serial correlation.

Now, that the residuals are serially uncorrelated the results required under Baeulieu and Miron (1993) have been generated. Table 6.2 contains the results.

Table: 6.2
Result: Seasonal Unit Root test

| Series | Deterministic | LM Stat. (computed) | Hypothesis $t_1$:=0 | Hypothesis $t_2$: =0 | Hypothesis $F_{3,4}$ ($\pi_3=\pi_3=0$) | Hypothesis $F_{5,6}$ ($\pi_5=\pi_6=0$) | Hypothesis $F_{7,8}$ ($\pi_7=\pi_8=0$) | Hypothesis $F_{9,10}$ ($\pi_9=\pi_{10}=0$) | Hypothesis $F_{11,12}$ ($\pi_{11}=\pi_{12}=0$) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Critical Values (5% Significance level) | | | | | | |
| | C, sd | | 2.81 | 2.81 | 6.42 | 6.42 | 6.42 | 6.42 | 6.42 |
| | C | | -2.80 | -1.89 | 3.01 | 3.01 | 3.01 | 3.01 | 3.01 |
| | | | Computed Values | | | | | | |
| $dc_t$ | C, sd | 15.36 | 2.39 | 3.04 | 10.06 | 12.15 | 9.01 | 16.91 | 10.54 |
| $emp_t$ | C, sd | 10.70 | 2.39 | 4.66 | 17.83 | 17.86 | 18.97 | 18.43 | 18.60 |
| $i_t$ | C, sd | 11.09 | 3.50 | 3.71 | 11.41 | 12.11 | 13.18 | 11.53 | 10.18 |
| $y_t$ | C, sd | 8.93 | 4.12 | 3.13 | 9.64 | 6.53 | 6.31 | 11.39 | 4.68 |
| $z_t$ | C, sd | 11.09 | 2.34 | 4.18 | 9.89 | 16.39 | 15.66 | 24.43 | 11.60 |
| $\pi_.^*$ | C, sd | 12.64 | 3.16 | 4.82 | 23.25 | 19.63 | 14.40 | 21.12 | 9.43 |

Note: C =Constant and SD = Seasonal Dummies
Critical value for BG LM test at 5 percent significance level: 21.03

Examination of the Table 6.2 shows that all the computed values exceed the corresponding critical values (developed by BM). The result establishes that unit root does not exist at zero or seasonal frequencies in any of the data series. Therefore we conclude that all the series are stationary. The result is not surprising as the system incorporates all the variables in growth form.

# 7 History: Exchange Rate and Monetary Policy[21]

The history of external account and monetary regime practiced in Pakistan, since independence, is discussed in this chapter. The review is essential to understand how the monetary regime, exchange rate regime and reserves management has changed overtime and what were the consequences of the developments overtime in this respect.

## 7.1 Exchange Rate and Balance of Payments

In this section we review the developments regarding the exchange rate, especially the impact of the decision to devalue or not to devalue at different times. The changes in exchange rate regime and the ensuing influences are also discussed.

Since independence in August 1947 to January 1982, Pakistan maintained a fixed – peg regime for its exchange rate. Initially, in 1947, the Rupee was linked to Pound Sterling and Pakistan was a member of Sterling area. Later as the U.S. became more dominant across the globe and Pakistan's fortunes became more aligned to USA, the US dollar became the key currency for Pakistani Rupee, as it did with most other currencies.

As early as September 1949, the Pound, to which, the Rupee was pegged, was devalued by 37 percent. Most of the currencies, pegged to Pound, follow suit. However Pakistan chose not to devalue. The objective among others was to sell jute, now at a higher price, to India. However the strategy did not work as India retaliated by discontinuing trade altogether with Pakistan. India at that time imported 55.8 percent of Pakistan's total exports. The discontinuation of trade obviously had a severe negative impact upon Balance of Payments. Pakistan coped with the situation by rationing imports. Thus rather than using the exchange rate or reserves for managing exchange market pressure quantitative restrictions on imports were employed for the purpose.

The Korean War started in June1950 and with that a fear spread that this might trigger world war-III. Countries began to stockpile raw materials. Jute and cotton were in high demand and Pakistan reaped spectacular profit on export of these commodities. This to a large extent offset the loss of exports to India. In 1952 the war led boom came to an end. Pakistan, once again, faced a serious balance of payments crisis. The exchange rate being overvalued, devaluation was expected to handle the BOP crises. Theoretically

[21] For this Chapter we lean heavily on Zaidi, S. Akbar (1999)

devaluation would have encouraged exports leading to improvement in reserves position. However the government, perhaps being conscious of Pakistan's exports potential imposed very strict exchange controls and rationed imports to reduce the outflow of reserves and thus curb the BOP crises.

President Ayub's era (1959-69) is characterized by an overvalued Rupee and a *defecto* multiple exchange rate system. The objective was to encourage exports and discourage import of consumer goods. An export bonus scheme (EBS) was introduced that allowed exporters to receive certain percentage of their export proceeds in terms of transferable bonus vouchers in addition to Rupee equivalent of their export earnings. The bonus vouchers allowed the holders to: (i) purchase an equivalent amount of foreign currency at the official exchange rate that could be used to import any item on the bonus list, (ii) to sell the voucher at stock exchange at 1.5 to 1.8 times their face value. Thus the effective exchange rate for the recipient of bonus vouchers worked out to RS.6.19 to RS.7.62 per dollar as against the official rate of RS.4.76 per dollar. This compensated the exporters for the overvalued exchange rate (ADB, 1995, pp. 361-2). Empirical evidence suggests that export bonus scheme had a positive impact on manufactured exports. Mekal[22] found that introduction of the scheme moved the entire export function upward. Besides, Nurul Islam[23] found a high elasticity of exports supply with respect to export incentive schemes.

Export bonus scheme was also used to import items, not covered by import licensing system. The effective exchange rate for imports, prior to 1967, was quiet high – RS.11.90 per dollar as against the official rate of RS.4.76 per dollar. Hence the scheme was used mainly for the import of luxury goods. In 1967, as the foreign aid dwindled and foreign exchange became further scarce, a cash-cum bonus scheme was introduced, for the import of industrial raw materials. The scheme provided an intermediate rate of RS.8.33 per dollar. Following this, the export bonus scheme became something close to a full-fledged multiple exchange rate system at it operated on export as well as import side[24].

[22] Cited in Zaidi (1999, p. 94)
[23] Cited in Zaidi (1999, p. 94)
[24] For further evidence on multiple exchange rates see Gustav Papaneck (1967, p).

The Rupee was devalued only twice during 1947-82, once by 30 percent in 1956 and than by 131 percent in 1972. In February 1973, US dollar was devalued by 10 percent and thus the Rupee appreciated by 10 percent to RS. 9.90 per dollar—the official exchange rate, that remained in effect till the country switched over to Managed float in January 1982. As mentioned above, the first devaluation came in 1956 when the Rupee was devalued against Pound Sterling by 30 percent. For the next seventeen years, the official exchange rate remained fixed at RS.4.76 per dollar. During most of the seventeen years the Rupee was grossly overvalued, however Pakistan got away with an overvalued exchange rate because of three policy measures. One, Multiple exchange rates, through Export Bonus Voucher scheme, that was designed in a manner that it encouraged exports and discouraged imports of consumer goods. Two, quantitative restrictions on imports through import licensing system, Three, political allegiance to the US that allowed the country to receive substantial foreign aid. These measures put together, kept the exchange market pressure within manageable limits.

With, Bhutto's ascent to power in December 1971, the old order was drastically changed and the Rupee was devalued by 131 percent in 1972 to find its new value of RS.11 Per dollar, revalued later on to RS.9.90 due to depreciation of dollar). Besides the bonus voucher scheme and hence the system of multiple exchange rates was done away with.

The separation of East Pakistan December 1971, was a major structural break for what remained of Pakistan. Jute, tea and other exports from East Pakistan earned more than 50 percent of united Pakistan's export earnings. The massive devaluation of 1972 caused the exports to grow by 38.4 percent and 24.7 percent in 1972/73 and 73/74 despite the loss of export earnings generated by former East Pakistan. Without devaluation the adverse impact of loss of export earnings on BOP would have been phenomenal. Thus exchange rate was managed, to manage exchange market pressure.

However the export boom was cut short due to quadrupling of oil prices in 1974. This on the one hand dramatically raised the oil import bill and on other hand contracted exports volume due to the recession that followed in the developed world. The obvious result was the worsening of the BOP. To add fuel to the fire, Pakistan had a series of bad crops due to floods, pests and other natural factors that affected cotton and rice –

Pakistan's two main exports. Hence the positive affect of devaluation was soon lost and the rebound was particularly severe.

Though the Bretton woods system came to an end in 1973, Pakistan, of its own accord, continued to peg the Rupee to US dollar, till January 7 1982. Upon IMF's recommendation, the pegged system was replaced by flexible (in spirit; managed) exchange rate mechanism, on January 8, 1982. Under the mechanism, State Bank of Pakistan (SBP) used to set a rate for Pakistani Rupee based on weighted average of the currencies of Pakistan's major trading partners. For much of the 1980's the the State bank used to nominally depreciate the Rupee by a few Paisas periodically. Since 1993, the gradual depreciation has been supplemented by sudden direct devaluations. Table 7.1 lists the instances of direct devaluations.

Table: 7.1
Exchange Rate: Major Devaluations since adoption of Managed Float in 1982

| | Exchange | Devaluation | | Exchange | Devaluation |
|---|---|---|---|---|---|
| June 93 | 27.09 | | May 98 | 43.94 | |
| July 93 | 29.78 | 9.93 | June 98 | 45.89 | 4.44 |
| Sept.95 | 31.47 | | May 99 | 46.0 | |
| Oct.95 | 34.16 | 8.55 | June 99 | 51.69 | 12.37 |
| Aug.96 | 36.88 | | Oct.2000 | 51.79 | |
| Sept.96 | 40.02 | 8.51 | Nov.2000 | 58.44 | 12.84 |
| Sept.97 | 40.42 | | | | |
| Oct.97 | 43.94 | 8.71 | | | |

Analyzing the table 7.1 it seems more than a coincidence that period in which direct devaluation was resorted to were the ones when political government were in power. Perhaps the conclusion is that political governments being more conscious of the Public's reaction tend to delay the day of reckoning. Therefore they avoid the frequent depreciation but then have to resort to a major devaluation to make up for not depreciating earlier.

Besides the very controlled nature of the foreign exchange market of the 80's gave way to a more open market in the 90s (ABN AMRO, 1995). What's important is that under the system, the official exchange rate used to be specified by SBP on a daily basis. The rate dictated by forces of demand and supply–the market rate, was determined in open (Kerb) market. As the exchange rate in the official market was regulated, the word Kerb market came to signify the open market where the exchange rate was determined by

market forces. Kerb traders are legitimate forex traders who work outside the banking system. At least, till 9/11 the remittances through the kerb market remained largely un-documented and market exchange rate used to be at a sufficient premium over the official rate besides the remittances were swifter through this market relative official banking channel. Given these features of the kerb market, overseas Pakistanis preferred to remit money through this market.

Since, the Rupee was allowed to 'manage float', in 1982, its value depreciated by 364 percent till May 27, 1998-The day just prior to nuclear detonation by Pakistan. On May 28, 1998, much to the dislike of the developed West, Pakistan went Nuclear and invited economic sanctions (mainly related to foreign aid) in return. This aggravated the problem of availability of foreign exchange to pay for imports.

To add fuel to the fire the government feared a run on foreign currency deposits in the wake of the sanctions. The fear was not misplaced as the foreign currency deposits then totaled a staggering sum of $10.9 billion as against foreign currency reserves of $1.2 billion[25]. Given the situation, the default on foreign currency deposit as well external liabilities became an imminent possibility. The authorities coped with the situation by freezing foreign currency accounts, devaluing the Rupee by 4.4 percent and initially rationing the availability of foreign exchange as well. For almost a week, following the detonation, the forex (kerb) market was forced to remain closed. The official exchange rate was kept fixed at RS.46 to a dollar for the next eleven months. The market rate however continued to depreciate steeply. The growing divergence between the official and market exchange rates discouraged overseas workers' remittances, through official banking channel, and virtually suspended other capital flows. Disbursements from international donors, multilateral as well as bilateral, were withheld on account of sanctions. The only element that somewhat pacified the pressure on BOP was the Saudi Oil facility; negotiated after the sanctions. The facility allowed Pakistan to import a certain share of its oil requirement from Saudi Arabia for credit.

The freeze on Foreign currency deposits, depreciation of Rupee by 4.4 percent , closure of the kerb market for a week and rationing of foreign currency did not prove

[25] Mirakhor and Zaidi (2006) and SBP annual report (1996-97) extensively discusses the negative implications of FCDs. These are discussed in section 8.4 of this study.

enough to calm down the kerb market that has been under severe pressure since the detonation. Accordingly, a number of changes were made in Pakistan's exchange rate regime in financial year 1998-99. Some of the important changes are described below:

### 7.1.1 **Two-Tier Exchange Rate System:**[26]

A two-tier exchange rate system was introduced on July 22, 1998. The system comprised:

a) Official exchange rate, b) floating inter bank rate (FIBR) and c) composite rate. The official exchange rate was determined by SBP while market forces of demand and supply determined FIBR. The composite rate was based on certain specified ratio of official rate and the FIBR, that was initially fixed at 50:50 (50 percent official and 50 percent FIBR) and was changed to 20:80 on December 21, 1998 and further to 5:95 on March 11,1999. All transaction, both receipts and payments were to take place on the composite rate, except for certain `specified categories, that were subject to official rate.

The system was aimed at *defecto* devaluation of Rupee, because ultimately FIBR had most of the weightage in the composite rate. The underlying aim was to encourage exports, discourage imports and to increase remittances from overseas Pakistanis through official banking channels.

Table: 7.2
Trade deficit: Before and After going Nuclear ($ in millions)

| | 97-98 | 98-99 | 99-00 | 00-01 |
|---|---|---|---|---|
| Trade Deficit | 3,264 | 2,085 | 1,412 | 1,269 |

The reduction in trade deficit, in absolute terms as well as percentage of GDP, evident from table 7.2 signifies that the objective of two-tier exchange rate mechanism was by & large fulfilled. However the mechanism did not cast any significant impact upon remittances. Besides the kerb market premium, remittances are sensitive to other factors like, efficiency of the channel in delivering money to the beneficiary and desire of the beneficiary to hold undocumented wealth. Given this, the reduction in kerb market premium was not enough to give a boost to remittances.

Though the *defecto* devaluation eased the pressure on Balance of payments, the introduction of two-tier exchange rate system meant multiple exchange currency practice.

[26] This section heavily leans on SBP Annual Report: 1998-99, pp.

The multiple currency exchange rates discriminate among different exporters and lead to cost/price distortions thereby resulting in misallocation of resources with adverse impact on output and growth. Moreover the acceptance of IMF'S Article-VIII obligations by Pakistan among others makes it obligatory to avoid recourse to multiple currency practice. It was therefore the first priority to move to unified exchange rate system as soon as the circumstances permitted.

### 7.1.2 **Unified Exchange Rate System**

The transitory arrangements of two-tier exchange rate system were replaced with unified exchange rate with effect from May 19, 1999. Under this system, the practice of announcing the official rate was done away with and the determination of exchange rate was left to market forces influencing the inter bank market. The rate prevalent in the interbank market is now officially taken as the nominal exchange rate at which all foreign exchange transactions take place. Foreign exchange requirements for all approved purposes (including import of goods, services and debt repayment) are to be met by the authorised foreign currency dealers from the inter bank market. SBP neither sells to, nor purchases foreign currency from authorised dealers as a matter of obligation. However as part of exchange rate management, the SBP does sell or purchase foreign currency on its own account and at rates and timing of its own choice.

September 11, 2001 turned out to be a boon, for Pakistan's external account. The US believed that money for terrorist activities, was being laundered through informal channel, locally known as *Hundi/Hawaala*. A strict watch was initiated on the channel hence the people doing this business went underground. Overseas workers' who were using the informal channel for remittances had no option but to switch over to official banking channel. This is one of the main reason for the jump in remittances and foreign reserves of the country.

Table: 7.3
Remittances & Foreign Reserves before and after 9/11 ($ in millions)

| | 98-99 | 99-00 | 00-01 | 01-02 | 02-03 |
|---|---|---|---|---|---|
| Remittances | 1,060 | 984 | 1,022 | 2,341 | 4,191 |
| Foreign Reserves | 1,678 | 1,395 | 1,328 | 4,831 | 10,041 |

Pakistan's foreign policy in the post 9/11 era has contributed significantly to its improved external position. For the first time in many years, Pakistan recorded a current account surplus and its exchange rate appreciated significantly since September 2001. The exchange rate has moved from RS.64.20 per dollar on September 30, 2001 to RS.57.21 on December 2003-an appreciation of 10.8 percent. Given the jump in reserves, the appreciation could have been more sudden and steeper had SBP not purchased foreign currency from the market. The year-wise intervention activity of SBP is indicated in table 7.4 below.

Table: 7.4
Intervention Activity of SBP since 9/11 ($ in mil.)

| | 01-02 | 02-03 | 03-04 |
|---|---|---|---|
| Net intervention in forex market | 3859 | 4975 | 897 |

The intervention was undertaken to smoothen the appreciation of exchange rate so that the export competitiveness is not adversely influenced. Thus once again the management of exchange rate has played a crucial role in meeting the objectives set by the economic managers.

### 7.1.3 Conclusion: Exchange rate

From 1947-82 the exchange rate regime was fixed, during the period the exchange rate was devalued only twice. For most of the time Pakistan managed exchange market pressure either through import restriction or depletion of reserve. Pakistan could afford to avoid depreciation of exchange rate at the cost of depletion of reserves because the given the foreign aid, the reserves position was comfortable.

Since Pakistan adopted the managed float, the exchange rate, though at times overvalued, has moved in tandem with the market forces. Under managed float regime that Pakistan adopted the exchange rate was determined daily by the SBP using a formula that incorporated weighted average of some basket currencies of currencies[27]. The rate thus determined was considered the official rate and all transactions involving the

[27] Presumably the basket of currencies was selected and weights were assigned keeping in view the Pakistan's volume of trade with different countries. However the precise formula, the basket of currencies and the weights were never disclosed by SBP.

government or even private transactions through the banks were executed at this rate. Pre-9/11, the official rate, more often than not, did not truly reflect the influence of market forces however the rate prevalent in the kerb market accounted for these forces. In May 1999 the SBP stopped the determination of exchange rate and the rate determined in interbank market is now accepted as the official rate however the State Bank influences the exchange rate, as and when it deems fit, by intervening in the interbank market.

Post 9/11, various developments that include, international crackdown on informal channels of money remittance, write-off/ rescheduling of Pakistan's foreign debt and return of Pakistanis residing illegally in US contributed dramatic improvement in Pakistan's foreign reserves and therefore contributed to the considerable appreciation of exchange rate.

**7.2 Monetary Policy**

Monetary policy is concerned with regulation of quantity and cost of money and credit in the economy. Monetary policy establishes how much can, and should be invested; and by determining the cost of money, the policy helps economic agents to decide how much they want to save and what amount they may spend at a particular moment of time.

The monetary policy in developed world has by and large been kept outside the purview of the government. However in Pakistan, at least till 1991, the policy has been relatively much more government controlled. Interest rates have been predetermined and strict sectoral credits were defined.

As a part of the banking sector reforms undertaken at the time of nationalization of banks in 1972, a National Credit Consultative Council (NCCC) was established to determine, annually, the volume of credit that should be made available to the economy and to ensure the availability of credit to the hither to deprived sectors. Given the fiscal requirements of the government as spelled out in the National budget, the NCCC used to devise an annual credit plan that determined the volume of credit expansion and allocated credit to various sectors of the economy. Besides, the government used to borrow from the State Bank at a rate of 0.5 percent per annum, by selling its adhoc (on tap) treasury

bills. Commercial banks, owned by government, were required to invest 30-35 percent of their demand and time liabilities in government Paper. The paper carried an arbitrarily fixed return of 6 percent per annum.

Khan (1995) identifies the following adverse effects of the controlled monetary policy in vogue prior to 1991.

- Credit ceilings did not allow the banks to lend as much as they profitably could however they were required to accept as much deposits as came their way. This forced the banks to invest their excess funds in low yield government securities. Consequently the banks were discouraged to mobilize domestic savings through their vast network of branches.
- Given the rather high statutory liquidity reserve (SLR) of 30 percent (and at times even 45 percent) banks were forced to invest 25 percent of their deposit base in low yield government securities (besides 5 percent was cash reserve requirement that paid no return). This gave the government low-cost captive sources of funds, thereby making the fiscal deficit a less worrisome economic variable.
- Interest rates on National Saving instruments were greater than what the commercial banks were allowed to offer on their deposits. This encouraged disintermediation of bank deposits to National Saving Centers. Instruments offered by National Saving Centers being instruments of government debt, the disintermediation, on one hand crowded out private sector credit through commercial banks and on the other hand ballooned high-cost government debt.
- As the treasury bills were mainly demand driven, and were redeemable any time, therefore the government debt, through SBP, was of short term and adhoc (on tap) nature, requiring regular refunding. Thus the government did not have any control over its debt volume.

Thus between 1972 and 1991 monetary management entailed control over monetary expansion and the lending rates by specification of quantitative limits and issuing directives to banks. Directing credit to specified sectors by setting mandatory targets for banks also formed part of monetary management.

Zaidi (1999) argues that controlled monetary policy did help in achieving the objective of a reasonable growth rate with price stability. GDP grew at an average of 4.5 percent and 6.5 percent in ’70s and’80s respectively. Though the inflation rate, that

averaged 12 percent during the ’70s, can be termed rather high, but that according to Zaidi was due supply-side factors like oil shock of 1973 and floods causing damage to crops, rather than the monetary policy practiced then. However it is note worthy here that Pakistan had enjoyed access to cheap foreign aid in ’80s and this might also have given a boost to the growth rate rather than just the controlled monetary policy practice then.

### 7.2.1 **New monetary regime**

The controlled monetary regime described above came under attack from IMF/World Bank for obvious reasons. The two organizations sought a drastic restructuring of the financial system to replace it with a market-oriented system. Hence the financial liberalization initiated since 1991. The reforms were to:

a) Remove distortions and segmentations of the financial markets by creating a homogeneous market for government debt instruments in which all individuals and institutions can participate.
b) Create a mechanism for market based interest rate determination through regular auction of the government debt. The rate determined periodically through auction of government debt was to indicate the stance of monetary policy.
c) Abolish subsidized credit schemes, like export refinance, and put an end to directed credit schemes so as to allocate credit in response to market forces.
d) Create and encourage development of secondary market for government securities. These markets are considered absolutely essential for the success of auction programme of the government debt.
e) Strengthen the health and competitiveness of the banking system by recapitalizing and restructuring nationalized commercial banks, increasing their autonomy & and allowing the private banks to enter the market.

Much of what was regarded as monetary management, prior to 1991, now stands discarded. However it is noteworthy at the outset that despite the reforms described below, the interest rate for all practical purpose is still controlled by SBP. The SBP still does not conduct the auction process in its true spirit and rather arbitrarily chooses a cut off point for T.Bill yield. The SBP’s power to accept or reject bids of treasury bills in an arbitrary manner allows it to do so and thus the SBP successfully influences the interest

rate. Zaidi (2005) argues that the arbitrary and inconsistent actions in accepting and rejecting bids have raised suspicion that fiscal consideration, rather than monetary policy, has been determining force behind the debt management strategy. Besides the secondary market for government securities; a key element in well functioning money market, is yet to develop. Since the treasury bills and PIBs (Pakistan Investment Bonds) are non-redeemable before maturity, the absence of secondary market hinders the marketing of PIBs as these are considered less liquid.

Notwithstanding the failures of the new monetary regime described above, the important reforms undertaken in the arena of monetary management and the financial sector are indicated below.

- Open market operations (OMOs) is now the major instrument of monetary management since January 1995 ([However the auctioning of T-bills was initiated in 1991]. The government is supposed to raise funds for its budgetary needs, at the market rates of return, through auctioning of government securities. (SBP Annual Report, 1994-95)
- The system of credit ceiling for banks was discontinued since July 1992. Bank credit is now regulated by varying money supply through auctioning of T-Bills/OMOs, changes in SLR, the discount rate and by setting a credit-deposit ratio. The credit to deposit ratio that was perceived to be credit ceiling under a different nomenclature (Khan, 1995; p.49) was also abolished on September 30 1995.
- Maximum/minimum limits on lending rates stand removed. This is yet another measure towards greater market orientation of the monetary and credit policy. The State Bank however still controls the lending rate for concessionary export credit and credit for purchase of locally manufactured machinery. However to give these rates a feel of the market, these have been linked with the yield on 6-months treasury bills. Rates for agricultural loans, through ADBP are still controlled by the government.
- With the permission to open banks in the private sector, numerous smaller banks have emerged. Besides, accept for National Bank of Pakistan, now all major banks stand privatized with the result that around 88 percent of the banking assets are in private hands.

Given the monetary regime prevalent, before and after 1991, one may conclude that though some measures still need to be taken to make the monetary management truly market oriented. Basically the spirit of the OMOs need to be respected, however the developments so far reflect a step forward in the right direction. Though the change of monetary regime is considered the right step, the move is criticized on grounds of appropriate timing. After the adoption of the new monetary regime the nominal effective rate for domestic public debt rose from 6.0 percent to 11.5 percent per annum and interest payments on government debt trebled between FY 1989-94. Given this, it is felt that fiscal discipline should have preceded the change of monetary regime. In this context ADB (2002) notes that move towards market based management of monetary policy, though well intended was ill sequenced and somewhat premature in timing. The sudden quantum jump in debt servicing made the task of ensuring fiscal discipline all the more difficult and entangled the country into debt trap.

To conclude the discussion on monetary policy we examine whether the policy has been successful in maintaining price stability. It seems that in recent years, SBP has not done a good job at fighting inflation. It is evident from data in table 7.5 that despite the rising trend of inflation the SBP was rather slow to tighten the monetary policy and the T. Bill rate remained below the rate of inflation there by making the real interest rate negative.

Table 7.5
Growth, inflation and interest rates

| Year | GDP Growth | Inflation | T. Bill rate |
|---|---|---|---|
| 02-03 | 4.8 | 3.1 | 1.66 |
| 03-04 | 7.5 | 4.6 | 2.31 |
| 04-05 | 8.6 | 9.3 | 7.96 |

SBP's failure to contain inflation is all the more evident from the sharp increase in inflation rate during 2005 (Table 7.5). According to ADB (2005) both supply and demand factors contributed to higher inflation rate during the year. Increase in inflation was led by food prices, house rents and transportation charges. The record growth in credit to private sector, especially consumer credit, pushed up demand and put pressure on prices which is reflected in sharp increase in core inflation. (2005: 7.4%, 2004: 3.7%). The ADB report also notes that despite the rapid increase in inflation the SBP avoided

tightening of monetary policy because SBP was of the view the inflation was mainly supply driven. We feel that that SBP in its urge to maintain the growth momentum has avoided sufficient and timely tightening of the monetary policy.

# 8 Exchange Market Pressure: Key Influences

## 8.1 Introduction

Exchange Market Pressure is a composite variable, computed as sum of exchange rate depreciation and foreign reserves outflow scaled by monetary base. The need to have a composite measure arises because, given managed float exchange rate regime, the two variables viz. exchange rate changes and variation in foreign reserves on their own are not a sufficient guide to characterize the external account situation. For example, currently SBP is providing the foreign currency required to foot the country's oil import bill. This intervention is meant to stabilize the exchange rate at the desired level but at the cost of depletion of foreign reserves, to the extent of intervention volume. Given this, focus on exchange rate only, will paint brighter picture, of external account, than what actually is, while focus upon foreign reserves alone will paint a picture, bleaker than what actually is. It is apparent that as exchange market pressure (*emp*), being the composite measure, incorporates change in exchange rate as well as variation in foreign reserves therefore this measure will reveal the true picture in the situation referred above. Hence the importance of exchange market pressure. Remainder of the chapter follows the following plan.

Before we proceed to discuss the econometric results, it is worthwhile to broadly review the key features that had characterized Pakistan's external account of Pakistan's external account. This chapter is aimed at analysis of the said features. Exchange market pressure computed as 'sum of exchange rate depreciation and reserves outflow scaled by base money' is discussed in section 8.1. Impact of overseas workers' remittances, foreign currency deposits and Purchases of foreign currency from open (kerb) market by SBP are discussed in section 8.2, 8.3 and 8.4 respectively.

## 8.2 Trends in Exchange Market Pressure

The exchange market pressure is computed based on month-end figures, since the adoption of managed float by Pakistan in January 1982. Table 8.1 reports the computed *emp* on an annual basis (Financial year-wise).

Table-8.1
Exchange Market Pressure

| Year | ER growth (%) | FR growth (%) | emp (O/S) | Year | ER growth (%) | FR growth (%) | emp (O/S) |
|---|---|---|---|---|---|---|---|
| 81-82 | 4.11 | -0.78 | 3.33 | 92-93 | 0.82 | 0.54 | 1.36 |
| 82-83 | 2.10 | -2.64 | -0.54 | 93-94 | -0.13 | -1.92 | -2.05 |
| 83-84 | 0.65 | 1.28 | 1.93 | 94-95 | 0.13 | -2.02 | -1.89 |
| 84-85 | 0.0 | 0.94 | 0.94 | 95-96 | 0.78 | -4.79 | -4.01 |
| 85-86 | -0.36 | -0.10 | -0.46 | 96-97 | 0.17 | -2.02 | -1.85 |
| 86-87 | 0.29 | -0.06 | 0.23 | 97-98 | 4.44 | 4.63 | 9.06 |
| 87-88 | 1.70 | 3.80 | 5.5 | 98-99 | -0.58 | 0.54 | -0.04 |
| 88-89 | 0.0 | 0.78 | 0.78 | 99-00 | 0.00 | -0.64 | -0.64 |
| 89-90 | -0.50 | -2.56 | -3.06 | 00-01 | 2.54 | -0.41 | 2.13 |
| 90-91 | 2.11 | -0.91 | 1.19 | 01-02 | -0.18 | -7.22 | -7.4 |
| 91-92 | 0.12 | -3.06 | -2.94 | 02-03 | 0.33 | -2.29 | -1.96 |

ER: Exchange Rate, FR: Foreign Reserves
Note: Positive growth in ER implies depreciation of the currency

Of the two components of exchange market pressure changes in exchange rate have contributed lesser to the pressure as compared to changes in foreign reserves. Since the initiation of managed float in January 1982 till the end of our data span i.e. December 2003, the exchange rate had depreciated by 452 percent in a span of 22 years. During 1980's, by and large, the depreciation of exchange rate has been, very gradual, in accordance with the spirit of managed float, that is less than 3 percent per month (see table 8.1, it is noteworthy here that positive growth in ER implies depreciation of exchange rate). However the decades of 1990's has seen huge devaluation on some occasions as well. Depreciations exceeding three percent per month are listed below.

Table 8.2
Major Depreciations/Devaluation
of Pak Rupee in a single month

| Year/ Month | ER dep. | Year/Month | ER dep. |
|---|---|---|---|
| 1982M2 | 5.12 | 1991M3 | 3.62 |
| 1982M3 | 4.96 | 1993M7 | 9.93 |
| 1985M2 | 3.36 | 1995M10 | 8.55 |
| 1986M5 | 3.82 | 1996M9 | 3.80 |
| 1989M5 | 4.73 | 1997M10 | 8.71 |
| | | 1998M6 | 4.44 |
| | | 1999M5 | 12.37 |
| | | 2000M9 | 12.84 |

Major devaluation episodes during 1990s in contrast with gradual depreciation during 1980s could be examined using politico-economy argument. Depreciations are almost always unpopular with the public. It is relatively difficult for a democratic government to do what is unpopular with the public as compared to a military

government. A democratic government, especially an unstable one, tends to delay unpopular decisions as long as possible. If exchange rate is not allowed to depreciate as demanded by fundamentals, then one has to go for the sudden larger devaluation when the rate becomes highly uncompetitive. The fact that Pakistan had a military government in power during 80's while during most of the 90's (unstable) democratic regimes were in power, explains the situation referred above.

The contribution of changes in foreign reserves to exchange market pressure, as mentioned above, has been relatively larger. In the lines ahead we discuss the influences upon balance of payments that in turn directly influenced the level of reserves and indirectly the level of exchange rate.

Pakistan's trade plus services balance has through out its history remained in deficit. The deficit has been to a major extent financed by current unilateral transfers. Remittances, from overseas Pakistanis, have been on a declining course as early as 1983-84. By 1990-91 remittances had reached $1.4 billion as against the peak level of $2.9 billion in 1982-83. In 1990-91 a Resident Foreign Currency Account scheme was initiated. Under the scheme foreign currency deposits mobilized by banks were surrendered to SBP. Net inflows on account of Resident Foreign Currency Deposits (FCDs) along with remittances financed a significant part of the trade and service balance till the freeze of FCDs on May 28, 1998. As, with the freeze on FCDs a major avenue of foreign currency inflow stood closed, the authorities had to resort to outright purchase of foreign currency from the open (kerb) market. Table 8.3 furnishes year-wise figures of different components of unilateral current transfers, the current account balance, trade and services balance. Column 9 of the table shows the extent (in percent) to which the three types of transfers viz. Remittances, Resident FCDs and purchases of dollars from the kerb market have financed the deficit on trade and services account. Given the fact that the three type of transfers together have financed, for a greater part of our data span around 50 percent (on average) of the deficit on trade plus services account, the three components of BOP warrant greater focus:

Table: 8.3
Financing of Trade & Services through Current Unilateral Transfers
($ in millions)

| | Current Transfers | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) Remitta-nces ® | (2) FCDs (F) | (3) Purchases from Kerb/ interbank. (K) | (4) = 1+2+3 R+F+K | (5) others | (6) Total Current Tranfers | (7) Current Account balance | (8) Trade& Services balance | (9) =4/8 R+F+K to Trade & Services balance (%) |
| 1981-82 | 2,225 | - | - | 2,225 | 187 | 2,412 | -1,534 | -3,946 | 56 |
| 1982-83 | 2,886 | - | - | 2,886 | 195 | 3,081 | -517 | -3,598 | 80 |
| 1983-84 | 2,737 | - | - | 2,737 | 307 | 3,044 | -997 | -4,041 | 68 |
| 1984-85 | 2,446 | - | - | 2,446 | 241 | 2,687 | -1,680 | -4,367 | 56 |
| 1985-86 | 2,595 | - | - | 2,595 | 227 | 2,822 | -1,235 | -4,057 | 64 |
| 1986-87 | 2,279 | - | - | 2,279 | 278 | 2,557 | -719 | -3,276 | 70 |
| 1987-88 | 2,013 | - | - | 2,013 | 243 | 2,256 | -1,682 | -3,938 | 51 |
| 1988-89 | 1,897 | - | - | 1,897 | 203 | 2,100 | -1,934 | -4,034 | 47 |
| 1989-90 | 1,942 | - | - | 1,942 | 268 | 2,210 | -1,891 | -4,101 | 47 |
| 1990-91 | 1,848 | - | - | 1,848 | 206 | 2,054 | -2,113 | -4,167 | 44 |
| 1991-92 | 1,467 | 1,318 | - | 2,785 | 770 | 3,555 | -905 | -4,460 | 62 |
| 1992-93 | 1,562 | 543 | - | 2,105 | 579 | 2,684 | -3,331 | -6,015 | 35 |
| 1993-94 | 1,446 | 752 | - | 2,198 | 506 | 2,704 | -1,651 | -4,355 | 50 |
| 1994-95 | 1,866 | 381 | - | 2,247 | 511 | 2,758 | -2,163 | -4,921 | 46 |
| 1995-96 | 1,461 | 763 | - | 2,224 | 381 | 2,605 | -4,348 | -6,953 | 32 |
| 1996-97 | 1,409 | 1,347 | - | 2,756 | 491 | 3,247 | -3,557 | -6,804 | 41 |
| 1997-98 | 1,490 | 1,476 | - | 2,966 | 464 | 3,430 | -1,701 | -5,131 | 58 |
| 1998-99 | 1,060 | 539 | 873 | 2,472 | 375 | 2,847 | -1,856 | -4,703 | 53 |
| 1999-00 | 984 | 332 | 836 | 2,950 | 1,039 | 3,989 | -217 | -4,206 | 51 |
| 2000-01 | 1,087 | 534 | 1,031 | 3,778 | 959 | 4,737 | 326 | -4,411 | 60 |
| 2001-02 | 2,389 | 285 | 3,859 | 4,050 | 1,694 | 5,744 | 2,833 | -2,911 | 139 |
| 2002-03 | 3,537 | -12 | 4,975 | 3,525 | 3,212 | 6,737 | 4,028 | -2,709 | 130 |
| 2003-04 | 3826 | 367 | - | 4293 | 2321 | 6614 | 1812 | -2595 | 165 |
| 2004-05 | 4153 | 521 | - | 4674 | 3985 | 8659 | -1534 | -8807 | 50 |

Note: FCDs: Foreign Currency Deposits,
Source: SBP Annual Reports: Various Issues

### 8.3 Remittances: Favourable Impact on EMP

The oil shock of 1973 besides its worldwide inflationary impact, influenced many countries in different ways. The quantum jump in the fortunes of Middle-East nations led to enormous economic activity in these countries. Surge in economic activity led to

increased demand for labour in such countries and hence the export of human resource, unskilled as well as skilled from labour surplus countries, including Pakistan. The export of labour from Pakistan, to Middle-Eastern nations, following the oil shock led to a jump in remittances from overseas Pakistanis. Since then, the remittances have constituted an important source of financing the BOP deficit. However after reaching a peak of $ 2.9 billion in 1982-83; remittances started tapering off to reach the lowest level of $0.98 billion in 1999-00. The events following 9/11 acted as a boon for inflow of overseas remittances to Pakistan (through official channels i.e. the banking channel) with remittances rising to a record level of $3.54 billion by 2002-03.

The difference between the official and the non-official channel (locally termed *Hundi/Hawala* ), is that the foreign exchange received through the former is transferred to SBP at official exchange rate while the funds remitted through the latter remain in the kerb market and are purchased, (if the need be), by SBP at the kerb rate, that generally remained at a premium above the official rate. Thus any purchase from the kerb increases the cost of central bank. Besides the purchases from the kerb market fuel expectations of fluctuation in exchange rate and the economy has to bear the ensuing consequences. One reason for the gradual decline, since 1982-83, in the level of remittances is that overtime the use of non-official channels, for remitting funds had increased tremendously, causing a fall in remittances (through official channels).

Given 9/11, the international community felt that non-official channels were being used for funding terrorist activities. Hence, the crackdown on such channels. With the crackdown on non-official channels for transferring funds, overseas Pakistanis were forced to remit money through the official banking channels. Hence the sudden jump in remittances since 9/11 to reach a record level, from the low of $1.06 billion in 2000-01 to a high of $3.54 billion in 2002-03: an increase of $2.48 billion (234 percent) in a short span of two years. The preference for non-official channels was rooted in their relative efficiency and desire of the concerned people to hold undocumented wealth to avoid taxes. It's worth mentioning here that a fall in remittances did not essentially imply a decrease in inflows to Pakistanis from overseas Pakistanis rather it only meant a decrease in inflows through official channels. Thus a decrease in remittances meant a simultaneous increase (not essentially of equal magnitude) in supply of foreign currency in the kerb

foreign exchange market. (We explain later on in this section that foreign currency available in the kerb market had also been used over the years to fund the BOP deficit.) This explanation for the fall and rise in remittances is only a partial one. Other reasons for the falling trend in remittances include the slowdown of the construction boom in the Middle-Eastern nations, partial replacement of Pakistani labour with cheaper labour from India and Philippines and the Gulf war of 1991.

Regarding the sudden jump in remittances it's noticeable that considerable increase has been recorded in inflows from the western nations, particularly United States, besides the traditional source i.e. oil rich Middle-East nations. Table 8.4 substantiates this statement.

Table: 8.4
Country-Wise Remittances ($ in Millions)

| Year | | **82-83** | **01-02** | **02-03** |
|---|---|---|---|---|
| ME Countries | Amount | 2,383 | 1,070 | 1,894 |
| | % share | 82.5 | 45.7 | 45.2 |
| U.K. | Amount | 162 | 152 | 274 |
| | % share | 5.6 | 6.5 | 6.5 |
| U.S.A. | Amount | 134 | 779 | 1237 |
| | % share | 4.7 | 33.3 | 29.5 |
| Others | Amount | 208 | 340 | 786 |
| | % share | 7.2 | 14.5 | 18.8 |
| Total | | 2,887 | 2,341 | 4,191 |

Source: SBP annual Reports: Various issues

Explanations put forward, for the jump in remittances from western nations include the return of Pakistanis living in these countries, for years, without proper legal status. Such returning Pakistanis brought with them their life-time hard-earned savings in terms of foreign currency. Secondly, since 9/11 many citizens of third world, especially Muslims, considered their savings less safe in western nations. These people living in the West are believed to have transferred their savings back home. This caused a surge in remittances from the western nations. If these explanations are to be believed then it is apparent that the increase in remittances from western nations cannot be relied upon as a permanent change in trend, because the return of Pakistanis has eventually to stop.

To sum up remittances from overseas Pakistanis, through out the data span, have directly played a major role in improving the BOP and the exchange market pressure. There contribution has been on a declining course since 1982-83, however since 9/11 remittances have regained their important position. Finally, it is too early to consider the change in trend of remittances, for the batter, as a structural change.

### 8.4 Foreign Currency Deposits: Source of Financing BOP Deficit

To cope with foreign currency crunch caused by diversion of remittances to the kerb market and significant drop in multilateral/bilateral aid/loans the authorities introduced a Foreign Currency Accounts (FCAs) scheme.

In fact the banks were allowed to open foreign currency accounts as early as January 1973, specifically, to increase foreign savings available to finance government deficit and to provide a saving instrument to non-resident Pakistanis. In 1991 given the excess demand for foreign currency residents were also allowed to hold foreign currency accounts. The residents would usually buy foreign currency from the kerb market and hold it as FCDs[28]. The Income on these accounts was tax exempt and entailed some other concessions as well. Under the scheme banks were required to sell the foreign currency thus mobilized to the SBP against Rupee equivalents. In return the SBP would provide full forward cover to the banks against exchange rate deprecation. The yield on FCDs constituted the interest paid on deposits plus the exchange rate depreciation during the tenure of the deposits. The depreciation enhanced the yield because the depositor could now get more rupees for the dollars deposited then he had paid for to acquire the dollars. Thus FCDs were considered a better hedge against inflation relative Rupee deposits. The high and variable rates of inflation together with larger exchange rate depreciation had made FCDs all the more attractive. This is how the dollarization − conversion of Rupee savings into foreign currency, occurred (Mirakhor and Zaidi, 2006).

By the time FCAs were frozen total Foreign Currency Deposits (FCDs) stood at $10.9 billion that comprised of $6.9 billion from Resident FCDs and another $4.0 billion from non-resident FCDs. Thus a major part of the foreign currency inflows through FCDs

[28] Given the premium available in the kerb market, the market was mainly served by remittances from abroad.

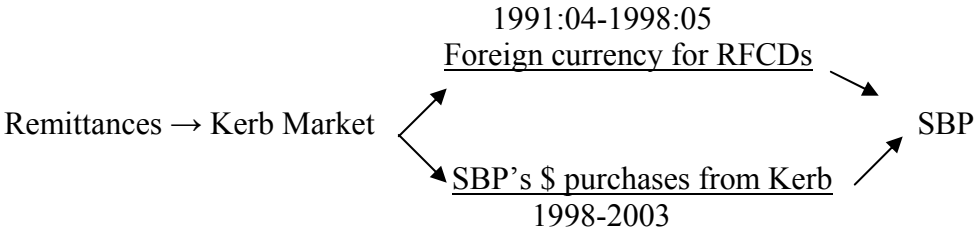
came from Resident FCDs. The causes and implication of dollarization for the economy in general and for exchange market pressure in particular are discussed later in this section. Table 8.5 highlights the motive (and the extent of its success) behind the introduction of Resident FCAs.

Table: 8.5
Key Current Unilateral Transfers ($ in millions)

| Year | Remittances | Resident FCDs (Net inflows) | Purchases from Kerb/Interbank market (net of sales) | Total |
|---|---|---|---|---|
| 82-83 | 2,886 | - | | 2,886 |
| 89-90 | 1942 | - | | 1,942 |
| 90-91 | 1,848 | 390 | | 2,238 |
| 91-92 | 1,468 | 1,318 | | 2,786 |
| 92-93 | 1,562 | 543 | | 2,105 |
| 93-94 | 1,446 | 752 | | 2,198 |
| 94-95 | 1,866 | 381 | | 2,267 |
| 95-96 | 1,461 | 763 | | 2,224 |
| 96-97 | 1,409 | 1,347 | | 2,756 |
| 97-98 | 1,490 | 1,476 | | 2,956 |
| 98-99 | 1,060 | 539 | 873 | 2,472 |
| 99-00 | 984 | 332 | 836 | 2,950 |
| 00-01 | 1,022 | 534 | 1,032 | 3,708 |
| 01-02 | 2,341 | - | 3,859 | 6,190 |
| 02-03 | 4,191 | - | 4,975 | 9,166 |

The picture portrayed in table 8.5 above shows that the inflows from three sources together have always remained above $2.1 billion, since the introduction of Resident FCDs in 1991. The data shows that the fall in inflows on account of drop in remittances were to a large extent, if not fully, compensated by inflows from resident FCDs for a period of seven years (1991-1998). Post-FCDs freeze, till 9/11, SBP's outright purchase of foreign currency, from kerb market, served the country's appetite for foreign reserves. As mentioned earlier part of the gradual drop in remittances reflected only the use of non-official channel for remitting money rather than the actual reduction in inflows on account of remittances. The only difference was that such remittances fed the kerb market

rather then directly ending up in SBP. However the ultimate destination of the remittances remained the SBP. The following flow chart shows the different routes through which the remittances ended up with SBP.




The flow chart shown above makes it clear that it were the remittances that actually served the appetite for foreign currency of potential FCD holders and the SBP. Therefore we may conclude that remittances continued to play, more or less the same role in financing the deficit on trade and services balances, during 90's, and onward, as played during major part of 80's. Though the resident FCDs and outright purchases from the kerb, by SBP, served to finance the BOP deficit, like remittances, but the two had some adverse implication for the economy that were not to be faced had banking channel been used, by overseas Pakistanis, for remitting money, instead of *Hundi/Hawala.* These adverse implications are discussed below.

### 8.4.1 Implications of Foreign Currency Deposits[29]

FCDs had served as a reliable store of value in times of high inflation and exchange rate depreciation however it appears that costs outweighed the benefits. The implications of FCDs are discussed at length in this section.

**a)** Purchase of foreign currency from the kerb market, for holding FCDs, put considerable pressure on exchange rate. To avoid steep depreciation of Rupee central bank had to intervene with sale of foreign currency in the market thereby leading to depletion of reserves. Thus on the one hand foreign currency inflows on account of FCDs alleviated exchange market pressure, on the other hand part of the alleviation was offset by depreciation of Rupee and depletion of reserves due to intervention.

[29] For this section we draw upon Mirakhor and Zaidi (2006) and the relevant section of SBP annual report 1997-98, pp. 109-23

**b)** FCDs had made it difficult for SBP to control inflation. The inflation contributed to the depreciation of Rupee that again contributed to inflation, there by creating a vicious circle. The roots of this vicious circle lie in the introduction of FCDs that had caused the money multiplier (M2/reserve money) to increase significantly. At the time of introduction of FCDs in March 1991, the money multiplier was 2.10. By the time FCDs were freezed in May 1998 it had reached 3.24. The increase in multiplier was due the fact that the percentage share of Reserve money (i.e. domestic credit), mainly composed of currency in circulation, had declined overtime, while that of broad money (excluding Reserve money) had increased. It is shown below, that RFCDs being part of the latter have played a significant role in this shift. Table 8.6, shows the percentage share of the various components of M2 in its year-wise growth.

Table: 8.6
Percentage growth in components of money supply

| Year | CC | DD | OD | GM1 | TD | RFCD | GM2 |
|---|---|---|---|---|---|---|---|
| 87-88 | 39.5 | 45.4 | 0.8 | 85.8 | 14.2 | - | 13.7 |
| 88-89 | 44.6 | 41.4 | 0.4 | 86.4 | 13.6 | - | 12.2 |
| 89-90 | 79.1 | 64.5 | 15.5 | 159.1 | -59.1 | - | 4.6 |
| 90-91 | 49.4 | 44.4 | -2.6 | 91.2 | 8.8 | - | 12.6 |
| 91-92 | 42.5 | 3 | 1.7 | 47.2 | 34.4 | 18.4 | 16.3 |
| 92-93 | 13.3 | 21.3 | 0.2 | 34.8 | 35.2 | 30 | 30.3 |
| 93-94 | 16.7 | 9.7 | 1.3 | 27.7 | 51.9 | 20.3 | 17.8 |
| 94-95 | 16.5 | 11.2 | 1 | 28.7 | 42.8 | 28.6 | 18.1 |
| 95-96 | 25.4 | 28 | -0.4 | 53.1 | 36.3 | 10.7 | 17.3 |
| 96-97 | 16.3 | 4 | 1.5 | 21.8 | 42.3 | 35.9 | 13.8 |
| 97-98 | 8.8 | -12.9 | 0.3 | -3.9 | 36.7 | 67.2 | 12.2 |
| 98-99 | 18.8 | 5.7 | -0.5 | 24 | 39.6 | 36.4 | 14.5 |
| 99-00 | 19.9 | 199.6 | -0.3 | 219.3 | 93.2 | -212.5 | 6.2 |
| 00-01 | 56.7 | 21.8 | 1.5 | 80 | 27.1 | -7.1 | 9.4 |

Note: CC: Currency in circulation, DD: Demand Deposits,
OD: Other Deposits,
TD: Time Deposits, RFCD: Resident Foreign Currency Deposits

From the data in table 8.6 it is evident that the share of currency in circulation in M2 growth had ranged between 40-49 percent (except for an outlier of 79 percent in 1989) in the years prior to the introduction of FCDs in 1991. After the introduction of FCDs this share remained in the range of 13-19 percent. (except for an outlier of 25% in 1995) till the FCDs were frozen in May 1998. The table also shows that the decline in share of currency in circulation was made-up by the share of RFCDs and time deposits.

In 1996-97, the year just prior to the year of freeze (i.e.1997-98) the share of RFCDs in M2 growth was as high as 67 percent.

Though, in general the reduced share of currency in circulation is good for the economy but if the change is not anticipated by the authorities or the change is difficult to forecast then the conduct of monetary policy becomes difficult. The reason is that, under market based conduct of monetary policy it is the Reserve money that central bank targets as its operational target. But even if the central bank is able to achieve its reserve money target, it may still miss the broad money target due to unanticipated shift in the multiplier. It is felt that the operation of the vicious circle of inflation-exchange rate depreciation, made it difficult for the SBP to forecast the increment in volume of FCDs. Given this difficulty the SBP was not able to correctly forecast the multiplier. The inability to forecast the multiplier in turn led to monetary expansion beyond the targeted limit thereby contributing to exchange market pressure.

**c)** As the foreign currency mobilized through FCDs were surrendered to SBP these in essence constituted the liability of the SBP. An adequate coverage for meeting the liability was necessary and the onus of ensuring adequate coverage fell on the authorities. This being the case, foreign exchange reserves of the country were a natural coverage against FCDs. The persistent decline in the coverage of FCDs liability, as evident from decline in foreign reserves to FCDs ratio (Table 8.7, Column 5), had increased the risk perception of FCD holders. Given this the non-residents might have withdrawn their deposits or at least the growth trend came to a halt as the country-risk increased.

Table 8.7 below shows that the NRFCDs touched a peak volume $4.5 billion in January 1997, much before the freeze in May 1998. After reaching the peak level in January 1997, the NRFCDs steadily declined and were $4.0 billion at the time of freeze. This had happened at the time when the RFCDs were rapidly increasing and exacerbating exchange market pressure (*emp*) due to purchase of foreign currency from the kerb market. Thus NRFCDs, that used to alleviate *emp* due to inflow of foreign currency from abroad, were withdrawn at the very time these were badly needed. Thus the withdrawal contributed to the build-up of *emp*. However this may not be directly observable by looking at *emp* figures of two periods because several variables, are simultaneously

influencing the *emp*: some in positive direction and others in opposite direction; what is visible is only the net impact.

Table: 8.7
Month-Wise comparison of FCDs and Exchange Rate Depreciation

| | (Dollars in millions) | | | | (5) | (6) |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | FR/TFCD | ER dep. |
| Month | NRFCD | RFCD | TFCD | FR | (%) | (%) |
| Jan-1994 | 2,515 | 2,650 | 5,165 | 1,227 | 24 | 16.3 |
| Feb-1994 | 2,605 | 2,610 | 5,214 | 1,351 | 26 | 16.1 |
| Mar-1994 | 2,626 | 2,742 | 5,367 | 1,937 | 36 | 14.4 |
| Apr-1994 | 2,734 | 2,782 | 5,516 | 1,991 | 36 | 14.4 |
| May-1994 | 2,826 | 2,865 | 5,692 | 2,138 | 38 | 13.8 |
| Jun-1994 | 2,920 | 3,002 | 5,923 | 2,307 | 39 | 12.7 |
| Jul-1994 | 3,039 | 3,082 | 6,121 | 2,131 | 35 | 2.5 |
| Aug-1994 | 3,024 | 3,161 | 6,185 | 1,974 | 32 | 2.7 |
| Sep-1994 | 3,019 | 3,111 | 6,130 | 3,129 | 51 | 2.7 |
| Oct-1994 | 2,881 | 3,196 | 6,077 | 2,824 | 46 | 2.0 |
| Nov-1994 | 2,867 | 3,094 | 5,961 | 2,589 | 43 | 2.1 |
| Dec-1994 | 2,918 | 3,146 | 6,065 | 2,929 | 48 | 2.3 |
| Jan-1995 | 2,873 | 3,234 | 6,107 | 2,755 | 45 | 2.0 |
| Feb-1995 | 2,978 | 3,228 | 6,206 | 2,871 | 46 | 1.3 |
| Mar-1995 | 3,008 | 3,255 | 6,262 | 2,628 | 42 | 1.2 |
| Apr-1995 | 3,066 | 3,260 | 6,326 | 2,585 | 41 | 1.0 |
| May-1995 | 3,205 | 3,292 | 6,496 | 2,546 | 39 | 1.0 |
| Jun-1995 | 3,191 | 3,384 | 6,575 | 2,746 | 42 | 1.3 |
| Jul-1995 | 3,078 | 3,466 | 6,544 | 2,089 | 32 | 2.0 |
| Aug-1995 | 3,048 | 3,481 | 6,530 | 2,041 | 31 | 2.2 |
| Sep-1995 | 3,094 | 3,517 | 6,611 | 1,525 | 23 | 2.9 |
| Oct-1995 | 3,019 | 3,605 | 6,624 | 1,327 | 20 | 11.7 |
| Nov-1995 | 2,901 | 3,428 | 6,329 | 1,157 | 18 | 11.6 |
| Dec-1995 | 3,597 | 3,537 | 7,133 | 1,733 | 24 | 11.2 |
| Jan-1996 | 3,616 | 3,604 | 7,220 | 1,709 | 24 | 11.2 |
| Feb-1996 | 3,776 | 3,677 | 7,453 | 1,368 | 18 | 11.4 |
| Mar-1996 | 3,737 | 3,890 | 7,627 | 1,665 | 22 | 11.8 |
| Apr-1996 | 3,946 | 3,953 | 7,898 | 1,549 | 20 | 12.6 |
| May-1996 | 3,951 | 4,078 | 8,029 | 1,461 | 18 | 12.5 |
| Jun-1996 | 4,158 | 4,147 | 8,305 | 1,883 | 23 | 13.2 |
| Jul-1996 | 4,097 | 4,315 | 8,412 | 1,706 | 20 | 13.2 |
| Aug-1996 | 4,108 | 4,407 | 8,516 | 1,649 | 19 | 13.7 |
| Sep-1996 | 3,997 | 4,148 | 8,145 | 1,218 | 15 | 17.2 |
| Oct-1996 | 4,154 | 4,204 | 8,357 | 676 | 8 | 17.2 |
| Nov-1996 | 4,273 | 4,369 | 8,642 | 702 | 8 | 17.2 |
| Dec-1996 | 4,489 | 4,564 | 9,053 | 548 | 6 | 17.2 |
| Jan-1997 | 4,505 | 4,671 | 9,175 | 722 | 8 | 16.9 |
| Feb-1997 | 4,364 | 4,975 | 9,339 | 1,067 | 11 | 16.6 |
| Mar-1997 | 4,288 | 5,106 | 9,394 | 960 | 10 | 16.2 |
| Apr-1997 | 4,369 | 5,225 | 9,593 | 900 | 9 | 15.8 |

(Dollars in Millions)

| Month | (1) NRFCD | (2) RFCD | (3) TFCD | (4) FR | (5) FR/TFCD (%) | (6) ER dep. (%) |
|---|---|---|---|---|---|---|
| May-1997 | 4,356 | 5,317 | 9,673 | 1,080 | 11 | 16.0 |
| Jun-1997 | 4,352 | 5,491 | 9,844 | 1,249 | 13 | 15.3 |
| Jul-1997 | 4,139 | 5,551 | 9,690 | 1,351 | 14 | 14.7 |
| Aug-1997 | 4,078 | 5,621 | 9,699 | 1,515 | 16 | 13.8 |
| Sep-1997 | 4,112 | 5,657 | 9,769 | 1,193 | 12 | 9.6 |
| Oct-1997 | 4,414 | 5,812 | 10,225 | 1,663 | 16 | 9.8 |
| Nov-1997 | 4,289 | 6,000 | 10,289 | 1,339 | 13 | 9.8 |
| Dec-1997 | 4,181 | 6,285 | 10,465 | 1,195 | 11 | 9.8 |
| Jan-1998 | 4,055 | 6,425 | 10,480 | 1,052 | 10 | 9.8 |
| Feb-1998 | 4,031 | 6,697 | 10,728 | 1,144 | 11 | 9.8 |
| Mar-1998 | 4,043 | 6,976 | 11,020 | 1,271 | 12 | 9.8 |
| Apr-1998 | 3,992 | 7,175 | 11,167 | 1,372 | 12 | 9.5 |
| May-1998 | 3,990 | 6,920 | 10,911 | 1,278 | 12 | 9.1 |

Note: NRFCD: Non-Resident Foreign Currency Deposits, RFCDs: Resident Foreign Currency Deposits, TFCD: Total foreign Currency Deposits, FR: Foreign Reserves
ER dep.: Exchange Rate depreciation

It is evident from the data of table 8.7 that foreign reserves to TFCD ratio (a measure of risk coverage against FCDs) after reaching a peak of 48 percent in December 1994, (Table 8.7, Column 5) started deteriorating and was as low as 8 percent in January 1997: the time when NRFCDs touched their peak of $4.5 billion. Thereafter the percentage never went above 16 percent till the freeze in May 1998 and for the major part remained in the range of 10-12 percent. It is worth noting that since September 1996 to August 1997 the Rupee was persistently depreciating at a rather high pace of around 16 percent per month and thereafter till the freeze at a pace of around 9.5 percent per month. The decline in coverage coupled with the rapid depreciation of Rupee had increased the risk perception of the NRFCDs holders and perhaps this is the reason that the level of NRFCDs fell from $4.5 billion in January 1997 to $4.0 billion by the time of the freeze. On the other hand resident FCDs holders, in a bid to take advantage of the rapidly depreciating Rupee, were converting their Rupee savings into Dollars and placing them into FCAs. During February 1997-April 1998 NRFCDs declined by 11 percent whereas RFCDs recorded a rise of 54 percent. We understand that the increase in NRFCDs, due to foreign currency inflows, works only in one direction i.e. alleviation of exchange market pressure but the increase in RFCDs, due to purchases from kerb market, works both-ways

i.e. it alleviates pressure by providing the much needed foreign currency to the SBP and exacerbates pressure by forcing the exchange rate to depreciate.

Thus we can see that a part of the NRFCDs were withdrawn at a time when an increase in the same was badly needed. In this context Mirakhor and Zaidi (2006) argues that a BOP crises increase the country risk and given the ease with which funds could be transfer abroad, the non-resident FCD holders would convert their savings into foreign cash or transfer these abroad. There by aggravating the crises. Regarding the FCD scheme the authors note that there were many episodes in which non-resident capital inflows would slow down sharply or stop altogether. Thus foreign currency would become scarce at the very time it was needed.

d) FCDs had hampered the conduct of flexible exchange rate policy. Though there are many determinants of the movement in FCDs, exchange rate expectations are one of the key determinants. The expected depreciation led to build-up of FCDs. The large build-up of FCDs had been a problem in terms of self-fulfilling expectations and the creation of an artificial foreign exchange shortage. According to SBP annual report of 1996-97 (p. 120)

> "there had been times, when fundamental determinants were pointing towards an equilibrium exchange rate but the private sector had formed an expectation of the depreciation of Rupee for various non-economic reasons, including build-up of FCDs. Alternatively sometimes after the realignment of exchange rate, when it had been brought to an equilibrium level, the private sector formed its expectation of further depreciation of Rupee, not on the basis of fundamentals, but the most recent behaviour of exchange rate. It happened several times that after depreciation of Rupee that the spread between the official rate and the free market rate widened rather than narrowing".

Given the vicious circle of FCDs growth-Rupee depreciation-FCDs growth, it was not possible for the authorities to leave the exchange rate entirely to market forces The build-up of FCDs have fulfilled the expectations of exchange rate depreciation leading to higher intervention volumes i.e. larger depletion of reserves due to intervention. Table 8.8 below presents a comparison of exchange rate premium (kerb premium) and the level of FCDs growth. A cursory glance at the table shows that, that by and large, the two variables have moved in tandem. This confirms the view that Resident FCDs growth had contributed to the depreciation of exchange rate.

Table: 8.8

Kerb Market Premium and FCDs growth

| Month | (1) Official ER | ((2) Market ER | (3)=2-1 Kerb Pr. | Kerb Pr. as % of official ER | RFCD ($) | RFCD Growth (%) |
|---|---|---|---|---|---|---|
| Jan-1994 | 30.18 | 31.64 | 1.46 | 4.84 | 2650 | |
| Feb-1994 | 30.39 | 31.93 | 1.54 | 5.07 | 2610 | -1.51 |
| Mar-1994 | 30.42 | 31.58 | 1.16 | 3.81 | 2742 | 5.06 |
| Apr-1994 | 30.47 | 31.93 | 1.46 | 4.79 | 2782 | 1.46 |
| May-1994 | 30.57 | 32.05 | 1.48 | 4.84 | 2865 | 2.98 |
| Jun-1994 | 30.53 | 32.02 | 1.49 | 4.88 | 3002 | 4.78 |
| Jul-1994 | 30.51 | 31.44 | 0.93 | 3.05 | 3082 | 2.66 |
| Aug-1994 | 30.57 | 31.4 | 0.83 | 2.72 | 3161 | 2.56 |
| Sep-1994 | 30.57 | 31.33 | 0.76 | 2.49 | 3111 | -1.58 |
| Oct-1994 | 30.57 | 31.33 | 0.76 | 2.49 | 3196 | 2.73 |
| Nov-1994 | 30.62 | 32.08 | 1.46 | 4.77 | 3094 | -3.19 |
| Dec-1994 | 30.72 | 31.76 | 1.04 | 3.39 | 3146 | 1.68 |
| Jan-1995 | 30.78 | 31.86 | 1.08 | 3.51 | 3234 | 2.80 |
| Feb-1995 | 30.80 | 31.6 | 0.80 | 2.60 | 3228 | -0.19 |
| Mar-1995 | 30.80 | 31.61 | 0.81 | 2.63 | 3255 | 0.84 |
| Apr-1995 | 30.78 | 31.75 | 0.97 | 3.15 | 3260 | 0.15 |
| May-1995 | 30.89 | 31.93 | 1.04 | 3.37 | 3292 | 0.98 |
| Jun-1995 | 30.93 | 32.11 | 1.18 | 3.82 | 3384 | 2.79 |
| Jul-1995 | 31.11 | 32.6 | 1.49 | 4.79 | 3466 | 2.42 |
| Aug-1995 | 31.24 | 32.58 | 1.34 | 4.29 | 3481 | 0.43 |
| Sep-1995 | 31.47 | 32.76 | 1.29 | 4.10 | 3517 | 1.03 |
| Oct-1995 | 34.16 | 35.45 | 1.29 | 3.78 | 3605 | 2.50 |
| Nov-1995 | 34.16 | 36.2 | 2.04 | 5.97 | 3428 | -4.91 |
| Dec-1995 | 34.16 | 35.85 | 1.69 | 4.95 | 3537 | 3.18 |
| Jan-1996 | 34.24 | 36.03 | 1.79 | 5.23 | 3604 | 1.89 |
| Feb-1996 | 34.31 | 36.7 | 2.39 | 6.97 | 3677 | 2.03 |
| Mar-1996 | 34.43 | 36.87 | 2.44 | 7.09 | 3890 | 5.79 |
| Apr-1996 | 34.66 | 37.08 | 2.42 | 6.98 | 3953 | 1.62 |
| May-1996 | 34.74 | 37.6 | 2.86 | 8.23 | 4078 | 3.16 |
| Jun-1996 | 35.01 | 36.86 | 1.85 | 5.28 | 4147 | 1.69 |

Source SBP Annual Report, 96-97

e) Initially the forward cover against FCDs was provided free of cost, as the Rupee depreciated rapidly the SBP had to incur huge losses on this count. To offset these losses a subsidized forward cover fee of 3 percent per annum on US dollar deposits was introduced in 1992 but this was not enough to cover the cost. (The net losses on forward

cover fee during 1993-94 and 1995-96 were more than RS.13.0 billion). The SBP's losses on account of forward cover fee reduced its profits and that in turn adversely influenced the non tax revenues of the government. On the other hand tax revenues were also affected as the income on FCDs was tax exempt. Prima facie it looked that FCDs as source of foreign funds were less expensive as compared to borrowing from IFI's on commercial terms or from private credit markets. However to make a meaningful comparison one needs to account for the losses on account of exchange risk coverage incurred by SBP and the open foreign exchange position of the SBP.

f) FCDs, as mentioned earlier had led to the dollarization that in turn contributed to the depreciation of Rupee. When SBP sought to defend the Rupee by increasing return on domestic assets this increased the cost of funding for domestic banks. On the other hand if SBP did not defend then the public sector foreign currency debt was to increase.

g) In sharp contrast to the previous exchange control regime the FCD could be used for capital account transaction. Thus FCD had led to the *defecto* capital account convertibility. This convertibility coming at a time when full current account convertibility has not been achieved was somewhat premature. The rapid adjustments in the capital account would result in overshooting in the exchange markets, which would in turn magnify the impact that financial developments had on the real economy.

**Conclusion: FCDs**

FCDs had liberalized the capital account. The problems that had to be encountered due to FCD scheme serve to emphasize that though capital account liberalization in itself is a cherished task it calls for appropriate sequencing of reforms. The main reason for reliance on short term inflows i.e. FCDs have been the large fiscal deficit. But according to Kruger (2004) unsustainable fiscal deficit and open capital markets do not blend together. The reliance on FCDs increased the borrowed reserves and therefore increased the risk perception of the country. This had dampening influence upon investment and therefore upon growth.

SBP on its own did make an effort to persuade the government to abolish the scheme or at least modify the scheme to remove its adverse features[30]. However the

[30] SBP's special detailed note on the negative implications of FCDs, contained in its annual report 1997-98 was one such effort.

shortage of foreign currency on one hand and the interest of the bankers on the other hindered SBP's efforts of going too far. Banks could place the funds that they would get against surrender of FCDs in high-yield risk-free public debt while SBP absorbed the exchange risk. This had made the scheme lucrative for banks and therefore they were interested in continuation of the scheme.

### 8.5 Kerb Purchases

With the freeze of FCDs the via media for converting remittances into official flows through RFCAs stood closed. Besides with the aid-sanctions the already shrinking aid pipeline almost clogged. Given the scenario the authorities resorted to outright purchase of foreign currency from the kerb market to meet the BOP financing needs. The level of outright purchases of foreign currency from the kerb market are given in table 8.9

Table: 8.9
Purchases of Foreign Currency from Kerb market by Central Bank ($ in millions)

| **Purchase of Foreign currency by SBP** | 98-99 | 99-00 | 00-01 | 01-02 | 02-03 | 03-04 |
|---|---|---|---|---|---|---|
| From Kerb Market | 873 | 1,634 | 2,157 | 1,376 | 429 | - |
| From Interbank market | | | | 2,483 | 4,546 | 897 |

Source: SBP Annual Reports, Various Issues

Looking at the figures for purchases from the kerb market and average inflows on account of resident FCDs, one can conclude that the outright purchases merely replaced the inflows on account of RFCDs. The slightly higher purchases from the kerb reflects the role of outright purchases in offsetting the impact of the almost clogged foreign aid pipeline, that in turn was due to sanctions imposed on Pakistan by international community in May 1998.

#### 8.5.1 Adverse Implications of Outright Purchases

The outright purchase of foreign currency from the kerb by SBP is quite similar to the purchase of foreign currency from kerb market for holding FCDs. The only difference is that in the former case the player is SBP while in latter case the player is general public desirous of holding FCDs. As the market recognizes the transaction more than the player, therefore theoretically, effect of the two on the economy and the exchange market pressure should be similar and evidence shows that this has been the case as far as

direction of the impact is concerned. However degree of the adverse impact has been lower in the case of purchases by the central Bank. The reason is that Central bank being conscious of its economic management role and being a more informed and skillful player conducts its purchases in a manner so as to generate the least possible adverse impact on the economy. Besides outright purchases by SBP, unlike FCDs, do not generate a liability and therefore the country risk factor does not come into play, which in case of FCDs, as discussed earlier, had generated adverse repercussions, like dollarization, for the economy.

# 9 Empirical Results and Analysis

This chapter is aimed at reporting the empirical results obtained from estimation of empirical model given by equation (5.44). Results of statistical investigation aimed at determining the degree of monetary autonomy are also reported. Econometric/statistical investigation has been conducted for several data spans. Section 9.1 discusses the motivation for the data-spans used. In section 9.2 the results from Impulse Response Function are discussed. Section 9.3 reports and analyzes the results of Granger Causality test. Results of monetary autonomy estimated for Pakistan, for various data spans, are discussed in section 9.4.

## 9.1 Data Spans

This study tests the exchange market pressure model for the following data spans. Key characteristics of the data spans used are given below in table 9.1

Table: 9.1
Data Span: Characteristics

| From | To | Peculiarity | Length (Years) |
|---|---|---|---|
| 1991:04 | 2005:12 | Initiation of the move towards market based monetary policy | 14.9 |
| 1991:04 | 1998:05 | Life period of Foreign Currency Accounts | 7.2 |
| 1995:01 | 2005:12 | Initiation of Open Market Operation (OMO's), spelling further liberalization of monetary policy. | 11 |
| 1998:06 | 2005:12 | Post-FCDs freeze / 9/11 | 7.7 |
| 2001:09 | 2005:12 | Post 9/11 | 4.4 |

The motivation for the full span of 14.9 years has been discussed in chapter 6. The motivation for the sub spans follows[31]:

[31] Results shown in the main text have been estimated without structural dummies. However to test whether the results are sensitive to introduction of structural dummies, we have introduced dummies at 1995:01, 1998:06 and 2001:09, to account for the structural changes due to initiation of OMO's, freeze on foreign currency deposits/aid sanction and 9/11. The structural dummy for 9/11 is statistically significant in the interest rate equation while structural dummy for freeze on foreign currency deposits is significant in the exchange market pressure equation. The introduction of the dummies does not materially alter the results so as to affect our analysis. A comparative statement, showing impulse responses, for the full span — with and without introduction of dummies, is given at annexure 1.

### 9.1.1 **Sub Spans: 1991:04-1998:05 & 1998:06-05**

Foreign Currency Deposit Accounts (FCDs) during their short active life had been an important source of foreign currency for the authorities. Residents were allowed to open foreign currency accounts in 1991 but the accounts were frozen in 1998. The first one of the two spans referred above reflects the life span of foreign currency accounts and the second one encompasses the post-freeze period. Foreign currency accounts had led to the dollarization of the economy that in turn had influenced the level of exchange market pressure. Besides if the level of differential between domestic and foreign interest rate undergoes a change, this affects the level of capital flows and hence the exchange market pressure. However for the channel to be effective capital mobility is called for. The foreign currency accounts had provided some inward capital mobility. With the freeze on these accounts the inward capital mobility received a severe dent besides the dollarization came to a halt. As the avenue provided by FCDs for inflow of foreign currency stood closed, this obviously influenced the level of exchange market pressure. The use of the two spans, that cover the pre-freeze and the post-freeze periods, will allow us to analyze whether the FCDs influenced the choice of monetary policy instrument vis-à-vis exchange market pressure.

Secondly after the nuclear detonation, in May 1998, foreign aid sanctions were imposed on Pakistan that led to stoppage of almost all foreign aid. This also influenced the exchange market pressure. The post-freeze span will allow us to examine as to how the authorities managed the pressure in the crises period.

### 9.1.2 **Sub-Span: 1995:01-2005:12**

Move towards market-based management of monetary policy was initiated in 1991 but the switch over was gradual. In 1995 open market operations (OMOs) were introduced to manage the level of money supply and interest rate in the economy. With the introduction of OMO, monetary policy, according to SBP is market-based. However the critics point out that SBP still does not conduct the auction process in its true spirit and rather arbitrarily chooses a cut off point in T.Bill auctions. Zaidi (2005) notes, that despite the reforms the interest rate for all practical purpose is still controlled by SBP. The author further argues that SBP's power to accept or reject bids of treasury bills in an arbitrary

manner; allows it to successfully influence the rate. Given the SBP's claim that monetary policy is market-based and skepticism of the critics in this regard, the sub-span 1995-05 is meant to test whether the instruments of monetary policy have changed vis-à-vis exchange market pressure with the stated change in regime and if yes, since when.

9.1.3 **Sub-Span: 2001:10-2005:12**

Certain events triggered by 9/11 had an impact upon exchange market pressure. After 9/11 the foreign reserves registered a dramatic increase and the exchange rate for the first time in the country's history was on an appreciation course. It is important to see how the monetary policy reacted to the change in direction of exchange market pressure arising from the foregoing unanticipated developments. Hence we use the data-span 2001:09-2005:12.

**9.2 VAR Estimation of *emp* Model**

VAR estimation involves regressing each one of the endogenous variables on its own lags. To estimate the VAR system we must decide the lag order of the dependent variable to be incorporated in the VAR system. Besides following the standard AIC method for selection of lag order of the dependent variables we additionally ensure that residuals of the regressions that form part of the VAR system do not exhibit serial correlation.

To select the lag order of dependent variables 'general to specific' methodology has been employed i.e. we started with an arbitrary large ( i.e. 12) number of lags of the dependent variable and reduced the number of lags, till the residuals of all the regression exhibited no serial correlation. Use of the foregoing process delivers the lags mentioned against each data span in Table 9.2 These lags are in conformity with AIC method as well.

Table: 9.2
Data Spans: Lags of Dependent Variables for VAR system

| | Interval | Duration: No of Years | Lags of dependent variable |
|---|---|---|---|
| Full span | 1991:04-2005:12 | 14.9 | 4 |
| Post liberalization | 1995-2005 | 11 | 3 |
| FCDs Span | 1991-04-1998-05 | 7.2 | 2 |
| Post-aid sanctions/ 9/11 | 1998:06-2005:12 | 7.7 | 2 |
| Post 9/11 | 2001:09-2005:12 | 4.4 | 2 |

Results of the Brauch-Godfrey LM test, for serial correlation, employed on residuals of individual regression, comprising the VAR system, are reported below in Table 9.3.

Table: 9.3
Serial Correlation Test: Regressions of VAR System

| | Chi-Square values: Computed | | | | |
|---|---|---|---|---|---|
| | Full (91:04-5:12) | Post MP liberalization (95:01-05:12) | FCDs (91:04-98:05) | Post FCD Freeze (91:06-05:12) | Post 9/11 (01:10-05:12) |
| Lags of VAR system | 4 | 3 | 2 | 2 | 2 |
| **Series:** | | | | | |
| $dc_t$ | 15.40 | 21.54* | 18.07 | 15.94 | 21.45* |
| $emp_t$ | 8.35 | 19.37 | 18.16 | 12.08 | 19.91 |
| $i_t$ | 19.13 | 18.62 | 9.16 | 15.09 | 21.31* |
| $y_t$ | 17.12 | 14.59 | 20.74 | 18.64 | 19.74 |

Note: Chi-Square critical at 5% and 2.5% significance level is 21.03 & 23.34 respectively.
* Serially uncorrelated at 2.5% significance level

All the chi-squares values shown in table 9.3 are less than the critical chi-square values at specified confidence intervals. Therefore we cannot reject the hypothesis of no serial correlation in any case. As the results show that the residuals are free of serial correlation at specified lags therefore the VAR system can be estimated with the lags indicated in table 9.3 above. After determining the lag length for each data span, the VAR system as specified by equation (5.44) has been estimated for each data span.

## 9.3 **Impulse Response Functions (IRF's):**

As mentioned earlier in chapter 5 (Empirical Framework) coefficients of VAR system are difficult to interpret due to possible long length of lags of endogenous variables. The main tool for interpretation of VAR system then is the Impulse response function (IRF) generated by shock to innovation to each of the endogenous variables. Accordingly after estimation of the VAR system (for each data span), IRF's were generated by shock to innovation to the variables to be analyzed[32]. The results are presented below.

[32] Standard errors have been computed using analytic (asymptotic) method.

### 9.3.1 **Effect of Domestic Credit growth on Exchange Market Pressure:**

The relevant IRF's show that there is positive and contemporaneous affect of domestic credit growth ($dc_t$) on exchange market pressure ($emp_t$). Table 9.4 tabulates the significant IRF's for each of the data span studied.

Table: 9.4
Shock to: Innovation to Domestic Credit
Impact upon: Exchange Market Pressure

| | **Data Spans** | | | | |
|---|---|---|---|---|---|
| Periods | **Full** | **FCD** | **95-05** | **98-05** | **9/11** |
| 1st | 1.09<br>(5.52) | 1.99<br>(7.38) | 1.04<br>(4.73) | 1.29<br>(5.25) | 0.70<br>(2.59) |
| 3rd | | | | 0.68<br>(2.56) | |

t-statistics in parenthesis

It is evident from the table 9.4 that shock to domestic credit growth generates a positive and contemporaneous response from exchange market pressure. The monetary approach predicts that given full employment, the newly created domestic credit is spent on import of goods and services or on acquisition of assets abroad. Thus the response is in conformity with the theory and is as hypothesized as well, that is, increase in domestic credit causes the exchange rate to depreciate or the foreign reserves to deplete or some combination of the two, that is, exchange market pressure.

### 9.3.2 **Feedback Relation: Effect of Exchange Market Pressure on Domestic Credit:**

The relevant IRF's for the full data span (91-05), the sub span that cover the life of FCDs (91-98) and the post monetary policy liberalization period (95-05) depict a positive impact of the shock to exchange market pressure ($emp_t$) on domestic credit growth ($dc_t$). No statistically significant response is noticeable in the post FCD freeze/post-aid sanctions period and the post 9/11 span. The significant responses are shown in table 9.5

Table: 9.5
Shock to: Innovation to Exchange Market Pressure
Impact upon: Growth in Domestic Credit

| | Full | FCD | 95-05 | 98-05 | 9/11 |
|---|---|---|---|---|---|
| 2nd | | 0.81<br>(2.18) | | Nil | nil |
| 5th | 1.17<br>(2.16) | | 0.69<br>(1.94) | | |

t-statistics in parenthesis

Though the response of domestic credit growth to a shock to exchange market pressure is positive in the first three spans prudence however, demands just the opposite, that is, the authorities, when faced with exchange market pressure ($emp_t$) should contract the growth rate of domestic credit so as to curb exchange market pressure ($emp_t$). This should be the response in the light of prediction of monetary theory and the empirical fact (Table 9.4) that increase in domestic credit leads to increase in exchange market pressure and vice versa.

Despite the response being, prima-facie, imprudent as far as controlling exchange market pressure is concerned the result is in conformity with what others have found for different economies. It's worth recalling here that Tanner (2001, 2002) for Mexico and six East-Asian countries and Bautista and Bautista (2005) for Philippines also find a positive impact of exchange market pressure ($emp_t$) shock on domestic credit growth ($dc_t$). Their findings confirm a key element of Mexican and the East-Asian currency crisis, that the authorities sterilized foreign reserves outflow and responded by providing additional liquidity to the banking system. This worsened the already high exchange market pressure [Bautista and Bautista (2005)].

The positive response of domestic credit ($dc_t$) to exchange market pressure shock ($emp_t$) suggests that authorities in Pakistan too, tend to sterilize foreign reserves outflow on the pattern noticed in economies referred above.

To understand the rationale for the apparently imprudent response let us suppose that the monetary authority in Pakistan increases domestic credit by an amount 'x' to meet domestic fiscal needs or to boost economic growth rate. Now if the prediction of monetary approach to balance of payments is correct then there would be a corresponding decrease in foreign reserves of the country as the newly created money will flow out. Given this outflow, the authorities are faced with shortage of money supply. To meet the shortage the authority responds by expanding the volume of domestic credit yet again. Even if we circumscribe to the view that monetary approach does not hold for Pakistan, still that implies that one to one correspondence does not exist between increase in domestic credit and outflow of foreign reserves, this does not mean that no part of newly created domestic credit flows out. The positive response of domestic credit to shock to exchange market pressure, noticed here, only implies that outflow of foreign

reserve/exchange rate depreciation leads to increase in domestic credit. However the extent of increase is not discussed in this study.

Another possible explanation offered by Tanner (2001) for East-Asian countries, that could be valid for Pakistan as well is that, banking sector, when faced with loan defaults tend to avoid the same, by offering more credit to the defaulters. This is done in the hope of rehabilitating the projects to enable them to repay the amounts due to banks. This explanation seems partly true in case of Pakistan as well; as the1990s has seen loan restructuring exercises being undertaken, by commercial banks to rehabilitate sick projects. The SBP, under instructions from the government, asked the banks to undertake these rehabilitation exercises.

To understand the absence of statistically significant response in the sub spans 98-05 and 01-05 we need to recall that after 9/11 the foreign reserves registered tremendous improvement and the exchange rate, for the first time in Pakistan's history, was on an appreciation course. The increase in foreign reserves and exchange rate appreciation between September 2001 and December 2003 is given below in table 9.6.

Table 9.6
Exchange Rate Appreciation & Increase in Foreign Reserves

| | **Sept. 2001** | **Dec. 2003** | **Appreciation/ Increase** |
|---|---|---|---|
| Exchange Rate | RS. 64.20 | RS. 57.21 | 12 percent |
| Foreign Reserves | $2,149 | $10,941 | 409 percent |

Given the improvement in foreign reserves and appreciation of exchange rate the exchange market pressure remained consistently negative for 27 months (Oct.01-Dec.03). Even during the following two years, the exchange market pressure remained negative for eight out of 24 months. Thus out of the total span of 52 months, the exchange market pressure had remained negative for 35 months, this covers two-third of the data span. Thus there is reason to believe that monetary policy in the post 9/11 span would be different from the one practiced earlier.

Though, post 9/11, the central bank purchased substantial foreign currency from the forex market, there by increasing foreign reserves, however no statistically significant

impact is observed from exchange market to domestic credit because the intervention activity was almost fully sterilized.

The year-wise intervention activity of the central bank is depicted below in table 9.7.

Table 9.7
Purchase/Sale of Foreign currency by SBP

($ in million)

| Period | Interbank (net) | Kerb Purchases | Net Addition to Foreign Reserves |
|---|---|---|---|
| 1999-2000 | -797.0* | 1,633 | 836 |
| 2000-2001 | -1,126* | 2,157 | 1,031 |
| 2001-2002 | 2,483 | 1,376 | 3,859 |
| 2002-2003 | 4,546 | 429 | 4,975 |
| 2003-2004 | 897 | - | 897 |

Note: The figures with negative sign represent sale, remaining figures represent purchases
Source SBP annual reports (Various Reports)

For illustrative purpose the sterlization activity, during 2001-02, of the State bank is indicated below in table 9.8.

Table 9.8
Sterilization in 2001-02 (RS. In billions)

| | **Impact on SBP** | |
|---|---|---|
| | **NFA** | **NDA** |
| Interbank US $ purchases (net) | 150 | |
| Kerb Purchases | 84 | |
| Government borrowing from commercial banks (RS. 160.4 billion) | | |
| Retirement of Government securities with SBP | | -287 |
| Net Impact | 234 | -287 |
| Net impact on Reserve Money (Domestic Credit) | | -53 |

NFA: Net foreign Assets
NDA: Net Domestic Assets

From table 9.8 it is evident that the domestic credit growth of RS. 234 billion affected due to purchase of foreign currency by the State bank was more than offset by retirement of government borrowing from SBP. Thus the intervention activity, in 2001-02, was completely sterilized. Similarly out of the foreign currency purchased worth RS.291 billion in 2002-03, RS.206 million was sterilized (SBP 02-03, p.79). It is because

of this kind of sterilization that despite the huge foreign currency purchases against domestic currency, no significant response is observed, during the post 9/11 span, from exchange market pressure to domestic credit.

### 9.3.3 **Shock to Interest Rate: Impact upon Exchange Market Pressure:**

The statistically significant responses of exchange market pressure ($emp_t$) to interest rate shock are noted below in table 9.9:

Table: 9.9
Shock to: Innovation to Interest Rate
Impact upon: Exchange Market Pressure

| | Full | FCD | 95-05 | 98-05 | 9/11 |
|---|---|---|---|---|---|
| 1st | 0.43<br>(2.28) | 0.66<br>(3.06) | | nil | 0.67<br>(2.61) |
| 2nd | | | | | 0.97<br>(2.89) |
| 4th | | | 0.41*<br>(1.78) | | |

Note: t-statistics in parenthesis
*Significant at 10 percent level

The influence of domestic interest rate upon exchange market pressure is hypothesized as positive (section 5.5.2). As discussed, under empirical framework, interest rate may influence exchange market pressure via real money demand. The change in money demand could be either due to change in demand for domestic goods abroad or by making domestic securities more attractive relative to international ones.

The impact of shock to interest rate on exchange market pressure is positive in all the data spans, except the span 98-05, where no statistically significant response is observed. First we discuss the positive response observed in the FCD span, that is the FCD span and the post 9/11 span.

A possible explanation for the positive impact, during the FCD span, of interest rate shock on exchange market pressure, is that the increase in interest rate reduced money demand that in turn caused the exchange rate to depreciate. As explained earlier, in Chapter 8 (EMP: Key influences) the total yield on FCDs comprised the interest earned on FCDs plus the exchange rate depreciation. Higher the exchange rate depreciation, greater the yield on FCDs. As the exchange rate depreciation caused an

increase in yield on FCDs, therefore the depreciation contributed to increase in volume of FCDs with commercial banks. The surrender of the foreign currency thus mobilized by banks to SBP, increased foreign reserves thereby contributing to decline in exchange market pressure, however on the other hand exchange rate depreciation, contributed to the increase in exchange market pressure.

The fact that by and large the interest rate, during the FCD span, maintained an upward course and the ultimate response of exchange market pressure to interest rate shock is positive (i.e. increase) suggests that alleviation impact due to increase in foreign reserves was more than offset by the exchange rate depreciation. This view is corroborated by the fact SBP annual report 1996-97 warns the government of the negative implications of FCDs. This brings us to the question that why the government persisted with the scheme if the net impact of the scheme on exchange market pressure was negative. The ensuing analysis provides the answer.

Import coverage ratio, that measures the country's ability to meet its imports from forex reserves alone, is one measure used to determine the safe/optimal level of foreign reserves. Import coverage ratio that prevailed during the FCD span is shown below in Table 9.10.

Table: 9.10
Foreign reserves as percentage of imports

| Year | Imports ($ in billions) | Reserves (12-Month avg.) ($ in billions) | Import coverage (Avg. Resv. as % of imports) |
|---|---|---|---|
| 90-91 | 8,325 | 366 | 4.27 |
| 91-92 | 8,998 | 534 | 5.39 |
| 92-93 | 10,049 | 808 | 8.04 |
| 93-94 | 8,685 | 1,186 | 13.66 |
| 94-95 | 10,296 | 2,642 | 25.66 |
| 95-96 | 12,015 | 1,626 | 13.53 |
| 96-97 | 11,241 | 1,040 | 9.25 |
| 97-98 | 10,301 | 1,268 | 12.31 |

Assuming that foreign reserves volume of less than 12 weeks of imports (i.e. 25 percent of annual imports) reflects a crisis-like situation, then the table shows that during

the entire FCD-span the reserves held were precariously low in relation to imports and only once these barely crossed the danger mark of 25 percent of imports. Another indicator of reserve adequacy is the *Guidotti rule*, which says that reserves should be enough to meet scheduled external debt payments as well as the projected current account deficit (excluding interest payments) of the next 12 months. On this criterion, Pakistan did not have enough reserves on the beginning of any fiscal year till 2002-03 (SBP 2002-03, p.162).

It was this low level of foreign reserves that forced the government to continue with the FCD scheme and embrace the vicious cycle of *interest rate hike-exchange rate depreciation.* The exchange rate depreciation, in turn contributed to exchange market pressure. The positive influence that the inflow of FCDs exercised on foreign reserves was large not enough to offset the impact of exchange rate depreciation. Hence the positive response of interest rate to shock to exchange market pressure during the FCD span, that is, 91:04-98:05. We feel that it is the FCDs channel that has been operative. The positive response observed, in the FCD span (91:03-98:05) has also contributed to the similar response observed in the other two spans viz. full span and post monetary policy liberalization span (95-05) because apart of these span overlap with FCD span. The reason for the opinion is that post-FCDs freeze span (98:06-05:12) does not exhibit any impact of interest rate shock on exchange market pressure.

The positive influence of interest rate shock on exchange market pressure in the post 9/11 span, can be studied in two distinct parts. One; the period from 2001:09 to 2003:12 when the exchange rate was appreciating (8 percent appreciation), foreign reserves were on the rise and interest rate (6 month T.Bill rate) declined by 886 basis points (Sept.2001:10.50%, Dec.2003:1.64%). Second; the period from 2004:01 to 2005:12 when the exchange rate was depreciating (5% depreciation) and interest rate increased by 661 basis points (Jan 2004: 1.64, Dec. 2005: 8.25%). The positive correlation observed between the exchange rate movement and interest rate during the two periods is in conformity with the theory and is as hypothesized.

### 9.3.4 Feedback relation: Effect of Exchange Market Pressure on Interest Rate

The statistically significant responses of interest rate ($i_t$) to shock exchange market pressure ($emp_t$) are noted below in Table 9.11.

Table: 9.11
Shock to: Innovation to Exchange Market pressure
Impact upon: Interest Rate

| | Full | FCD | 95-05 | 98-05 | 9/11 |
|---|---|---|---|---|---|
| 1st | | | | | 0.07*<br>(1.66) |
| 2nd | 0.13<br>(3.70) | 0.12<br>(2.40) | 0.10<br>(2.64) | 0.07*<br>(1.68) | |
| 3rd | | | 0.09<br>(2.34) | | 0.07*<br>(1.64) |
| 5th | 0.08<br>(2.26) | | | | |

Note: t-statistics in parenthesis
* Significant at 10 percent level

Explanation for the positive response of interest rate ($i_t$) to shock to exchange market pressure ($emp_t$) can be found in what the literature labels 'interest rate defense of exchange rate' (Flood & Jeane, 2000, Tanner, 2002). Under this strategy the authorities when faced with exchange market pressure, respond by influencing a hike in domestic interest rate. Given international rate, the increase in domestic interest rate encourages capital inflows, provided capital mobility conditions are fulfilled.

1990's was not a good decade for external account scenario of Pakistan. Inflows from a major source, *viz*. remittances from overseas Pakistanis, had been on a declining course since 1983 (1981-82: $2.9 billion, 1999-00: $0.98 billion). Besides, international geo-political environment being not too favourable, foreign lending, bilateral as well as multilateral, was scanty and even that was available only on harsh terms. Given this scenario, the authorities, in March 1991, allowed the residents to hold Foreign Currency Deposits (FCDs) with commercial banks. These deposit accounts were freezed in May 1998. During this period, as the exchange market pressure was relatively high the authorities might have purposely influenced an upward movement in interest rate to attract deposits in foreign currency accounts.

Another possible explanation for the hike in interest rate in response to shock to exchange market pressure can be found in the dollarization phenomenon. As the public purchased foreign currency from the kerb market for holding foreign currency deposits, the additional demand for foreign currency in the kerb market caused the exchange rate to depreciate and improved the FCDs' yield (interest on deposits plus exchange rate depreciation), the increase in return on local currency deposits had to follow the increment in yield on FCDs', to discourage too much switch-off from local currency deposits to FCDs, because higher the switch-off, higher the exchange rate depreciation. On the other hand, as the inflows into FCDs provided the badly needed foreign exchange, therefore the authorities felt that these had to be encouraged as well.

Given the polar objectives of encouraging FCDs and avoiding excessive switch-off from local currency deposits the authorities had a dilemma at hand. Given the dilemma the authorities went for the vicious circle of *exchange market pressure-interest rate hike.* The vicious circle went on during the seven years life of FCDs, however its impact seems so pronounced that the positive impact of $emp_t$ on $i_t$ is observed even when the full span of 14.9 years is considered. The following table shows the extent of exchange rate depreciation and interest rate hike during the FCD span.

Table: 9.12
Exchange Rate Appreciation & Increase in Interest Rate

| | April 1991 | May 1998 | Increase/ Depreciation |
|---|---|---|---|
| Interest Rate | 8.80 % | 16.24 % | 85 percent |
| Exchange Rate | 21.81 | 43.94 | 101 percent |

Besides the increase in demand for foreign currency in the kerb market due to dollarization led to depreciation of Rupee. The exchange rate depreciation contributed to inflation and to control inflation the authorities had to respond with the increment in interest rate[33]. Whatever the mechanics, an important piece in the cycle leading to interest rate hike is the exchange rate depreciation which is a component of exchange market pressure. Hence the positive feedback from interest rate to exchange market pressure.

[33] To further study the implications of the dollarization on the macro economy or the sudden halt to it see Calvo (1998 and 2001)

The positive impact of ($emp_t$) on ($i_t$) for the span 1998-05 and 2001-05 is accounted for in the following manner:

The span 98-05 covers two shocks to exchange market pressure, a negative and a positive one, to the economy of Pakistan. The first, a negative one occurred at end of May 1998, when lenders imposed the aid-sanctions as Pakistan went Nuclear. The second shock, a positive one came with 9/11. Due to variety of reasons, explained earlier, the foreign reserves registered a dramatic improvement and the exchange rate recorded considerable appreciation. The positive impact on exchange market pressure ($emp_t$) of the latter shock to the economy is but obvious. Its important to note that even the former, negative shock to the economy, generated a positive impact on exchange market pressure due to; (i) the introduction of two tier exchange rate; (ii) conscious reduction in imports keeping in view the shortage of foreign exchange; and (iii) supply of partial oil requirement on credit from Saudi Arabia under the Saudi Oil facility negotiated in the wake of the aid-sanctions.

The two-tier exchange rate, introduced on July 22, 1998, required conducting the transactions involving foreign exchange at a composite rate, which was based on a certain specified ratio (initially 50:50) of the official rate (announced by SBP) and floating interbank rate (determined on the basis of demand and supply of foreign currency in interbank market). Besides certain specified transactions e.g. oil imports were subject to official rate. The data in table 9.13 below substantiates the assertion that Exchange market pressure reduced even between the post-FCDs freeze period and 9/11.

Table: 9.13
Trade deficit & Exchange Market Pressure ($ in millions)

| | Year | | | | | |
|---|---|---|---|---|---|---|
| | 1997-98 | 1998-99 | 1999-00 | 2000-01 | 2001-02 | 2002-03 |
| Trade Deficit | -1,867 | -2,085 | -1,412 | -1,269 | -294 | -359 |
| Exports | 8,434 | 7,528 | 8,190 | 8,933 | 9,140 | 10,974 |
| Imports | -10,301 | -9,613 | -9,602 | -10,202 | -9,434 | -11,333 |
| | | | | | | |
| $emp_t$ (Avg.)* | 1.34 | 0.07 | 0.34 | 1.7 | -3.6 | -4.2 |

*Avg. of emp at the beginning and end of the year.

It is apparent from table 9.13 that despite the sanctions exchange market pressure, as defined in this study, remained relatively low during 98-99 and 99-00 partly due to

reduction in trade deficit. That in turn was due to payment for certain goods (huge in volume e.g. oil), on official rate and the disincentive to import due to dependence on floating interbank rate, which in fact had meant the *defecto* devaluation of Rupee, because the floating interbank rate was much higher than the official rate.

Once the FCDs existing till May 28, 1998 were frozen, the dollarization came to a grinding halt for want of avenue, though the incentive to dollarize remained as the gap between official exchange rate and Kerb market continued to widen till September 2001. It may be mentioned that though fresh foreign currency accounts were allowed to be opened shortly after the freeze, but given the confidence shattering freeze, these accounts did not attract huge volumes for quite some time despite the fact that the incentive to dollarize remained given the huge kerb-market premium. With the halt to switch-off from local currency deposits to FCDs, due to de-dollarization, the SBP did not have to follow the vicious circle, referred above, of increase in exchange market pressure-hike in interest rate. Besides, the de-dollarization eased the liquidity situation of the market. Hence the decline in interest rate consequent upon reduction in exchange market pressure. Last but not the least the external account situation became extremely favourable after 9/11, with dramatic improvement in foreign reserves and considerable appreciation of exchange rate. Therefore the need to defend the Rupee was no longer there. This allowed the SBP to reduce the interest rate that otherwise was also required to give a boost to economic activity. The following statements emanating from SBP confirm the point.

> Improvement in the external sector also has a major impact on SBP policies ---- the absence of pressures on the exchange rate allowed SBP to reduce the Bank discount rate to all-time low. (SBP Annual report 2001-02, p.156)

> September 11 shocks were reverberating in the domestic economy by October 2001, with a sharp drop in the already low net credit growth, and a very uncertain export outlook. The SBP responded to this crisis by lowering the discount rate by an unusual 2.0 percentage points, taking it to an all-time low of 10.0 percent. (SBP Annual report 2001-02, p.79)

> The continued forex inflows coupled with low inflationary pressures during FY03 allowed, the SBP to reduce the discount rate to an all-time low at 7.5 percent in November 2002. This led to a lowering of lending rates. (SBP Annual report 2002-03, p.147)

### 9.3.5 Conclusion: IRF analysis

Before we conclude the analysis of IRF's it is very important to point out that size of the coefficients with respect to feedback from exchange market pressure to interest is

very small (table 9.11). Similarly the size of the coefficients with respect to impact of interest rate upon exchange market pressure (table 9.9) is also relatively small, especially when compared with size of the coefficients for the impact of domestic credit upon exchange market pressure (table 9.4) and feedback from exchange market pressure to domestic credit (table 9.5). Secondly in the context of impact of interest rate on exchange market pressure no significant response is observed in the post FCD span (table 9.9) besides the response observed, for the same relationship, in the post monetary policy liberalization span (95-05) is significant at 10 percent level. All these together clearly point out that evidence for the relationship between interest rate and exchange market pressure is, relatively weaker, especially when compared with evidence for the relationship between domestic credit and exchange market pressure. Besides whatever evidence is observed regarding the relationship between interest rate and exchange market pressure, explanation for that mainly revolves around FCDs, which due to the freeze in 1998 were available, in their original form, for only half the period of the full span. All this serves to point out that domestic credit and not the interest rate has remained the dominant tool of monetary policy. (The graphs of IRF's are shown from fig. 1 to fig. 4)

Fig. 1
Impulse Response Functions
Response of *emp* to one standard deviation *dc* innovation

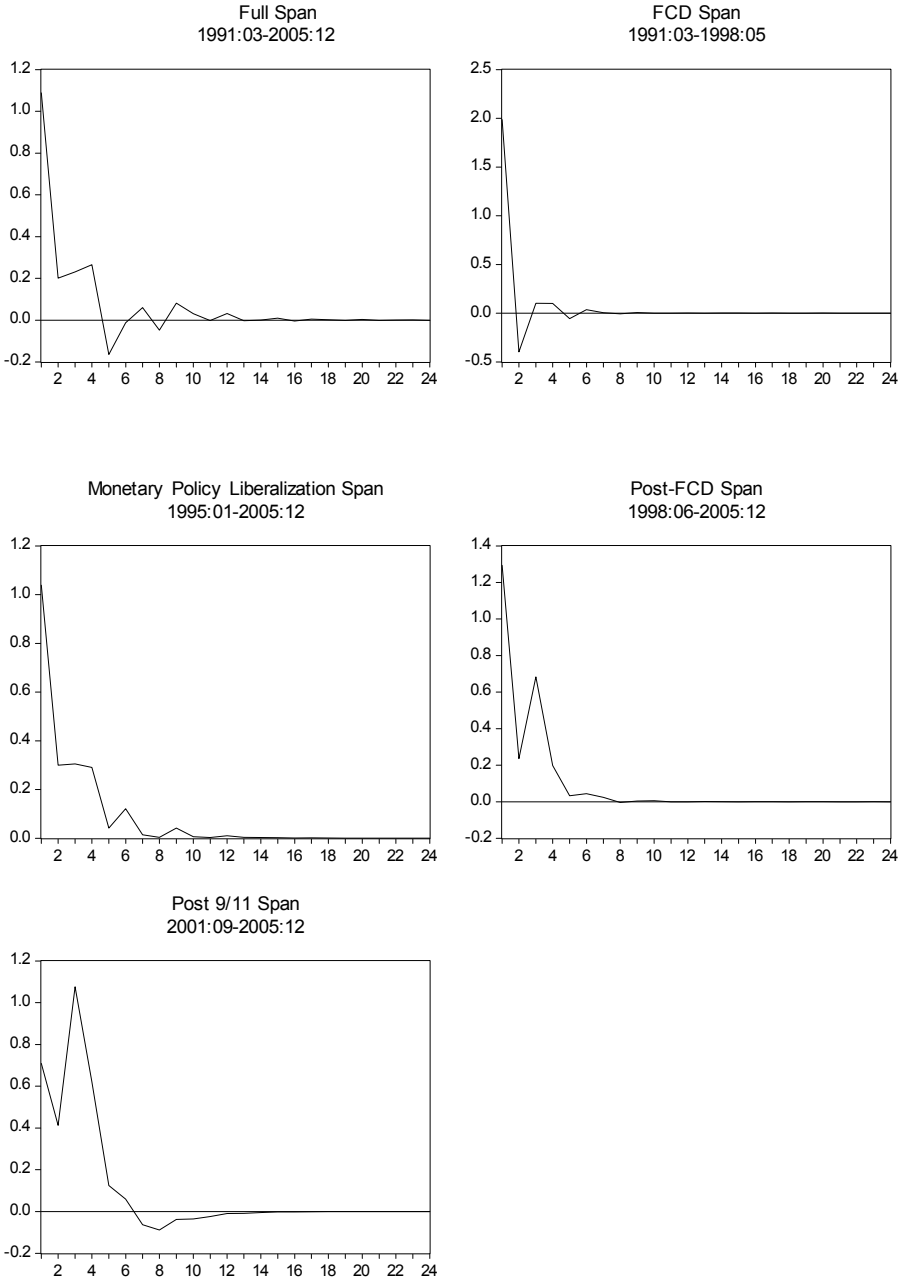


Fig.2
Impulse Response Functions
Response of *dc* to one standard deviation *emp* innovation

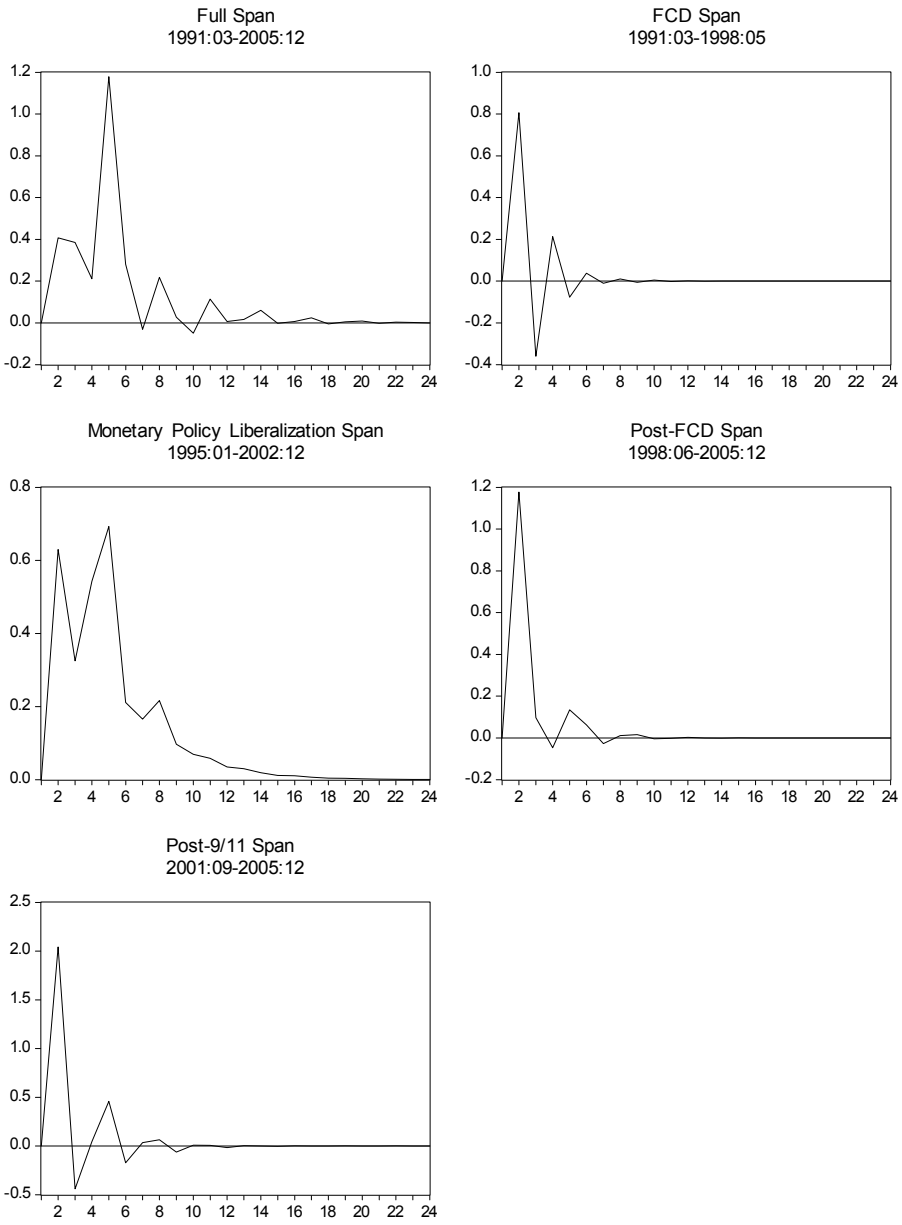


Fig. 3
Impulse Response
Response of *emp* to one standard deviation *i* innovation

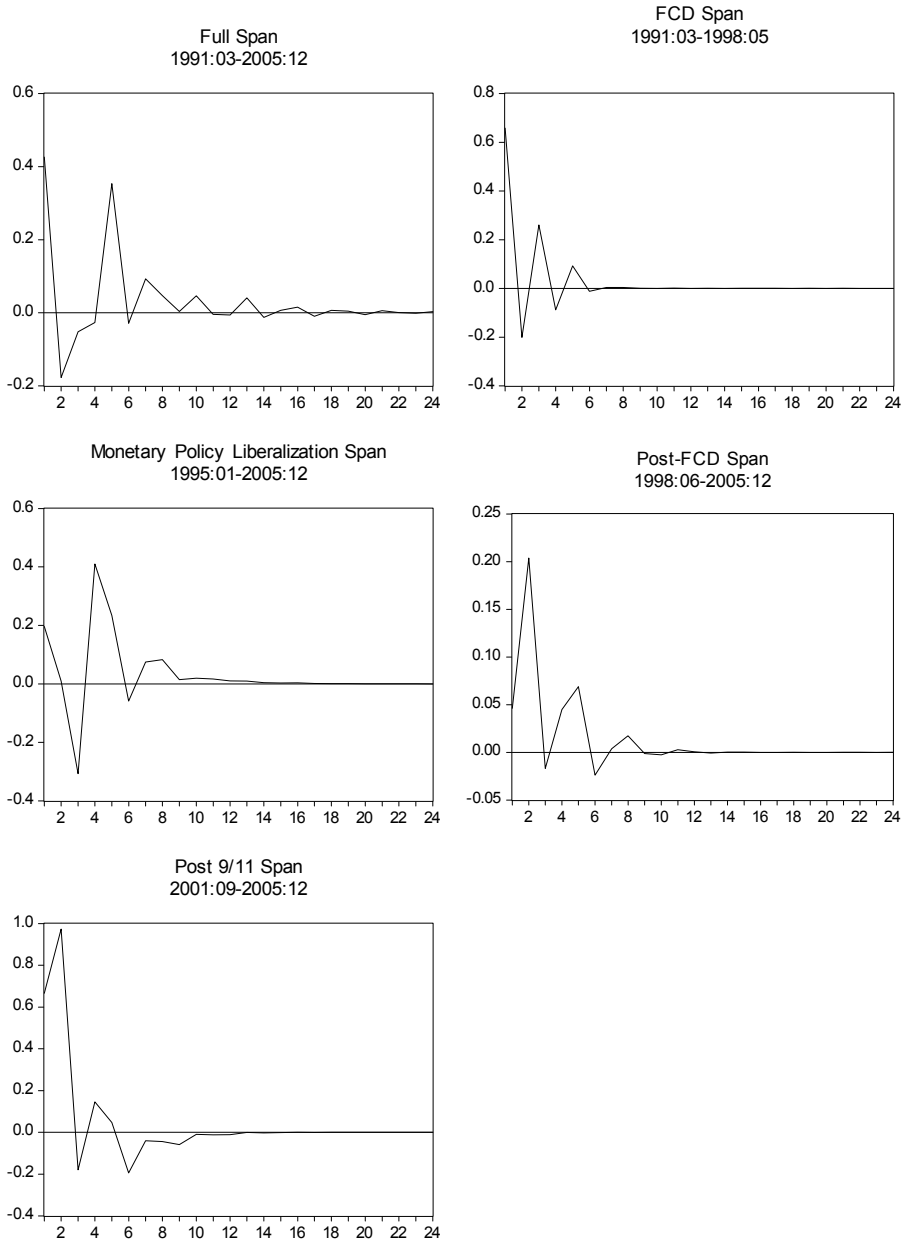
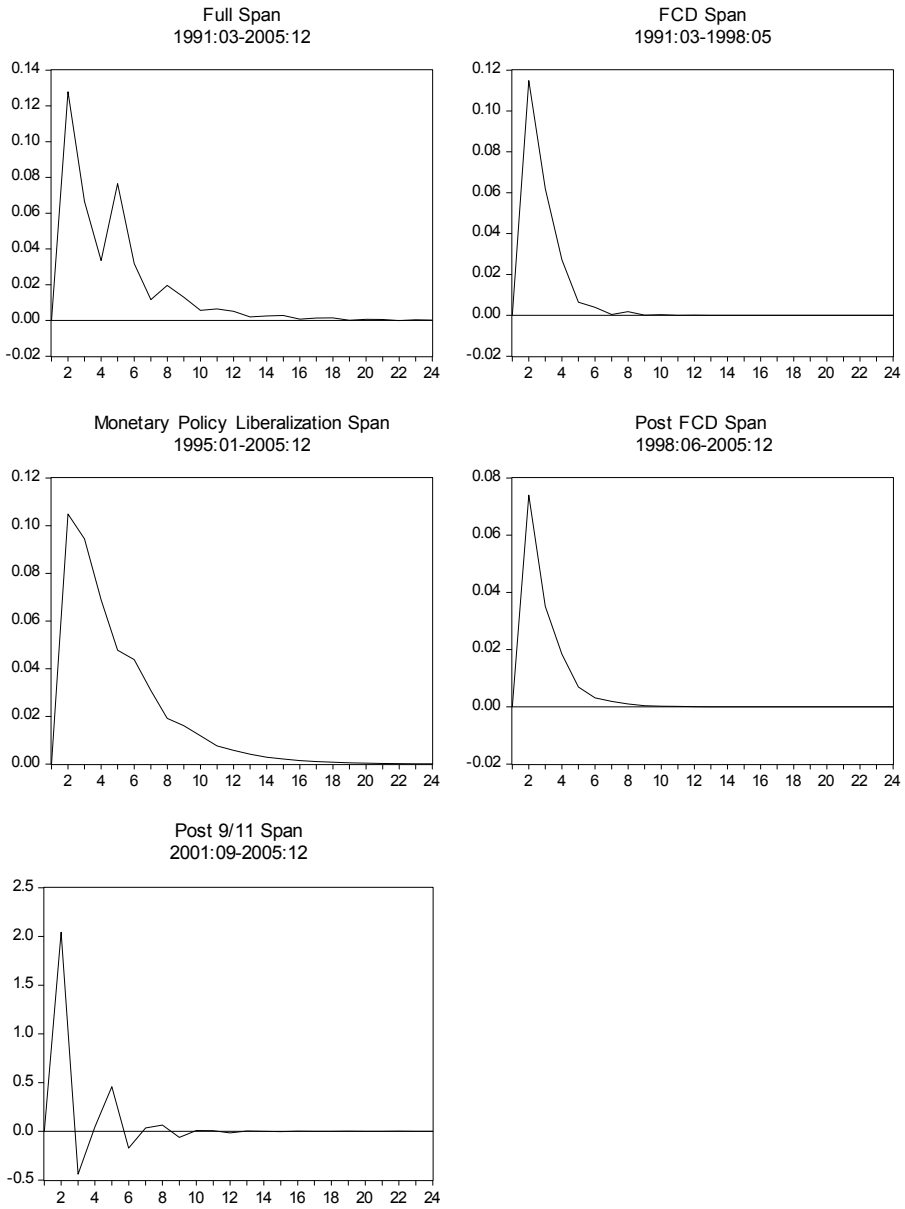


Fig. 4
Impulse Response
Response of *i* to one standard *emp* innovation



**9.4 Sensitivity Analysis**

As indicated in Chapter 6 (Empirical Framework) VAR results are sensitive to *ordering* of variables of the system. To guard against the possibility of *ordering*-based result, the results have to be checked against sensitivity to *ordering*. VAR results for the full data span under alternate *orderings* are presented below. The main *ordering* used in this study is [*dc-i-y-emp*]. The main *ordering* has $emp_t$ at the last place. Sensitivity of the results to *ordering* has been tested by estimating the VAR system and obtaining IRF's based on alternate *orderings* that place $emp_t$ at first, second and third place. The results are presented below.

Table 9.14 shows the impact of domestic credit upon exchange market pressure for the main *ordering* used as well as for, alternate *orderings*.

Table: 9.14
Sensitivity to Ordering of variables
Shock to: Innovation to domestic credit
Impact upon: Exchange Market pressure

| Period | *ordering* used *dc-i-y-emp* | Alternate Orderings | | |
|---|---|---|---|---|
| | | *dc-i-emp-y* | *dc-emp-i-y* | *emp-dc-i-y* |
| Ist | 1.09<br>(5.52) | 1.08<br>(5.53) | 1.08<br>(5.52) | 0.35<br>(1.74) |

Note: t-statistics in parenthesis

It is apparent from the table 9.14 that the results, regarding the impact of domestic credit upon exchange market pressure are insensitive to all the alternate orderings that place $emp_t$ after $dc_t$. However the ordering that has $emp_t$ in the first place (and thus prior to $dc_t$) alters the to the extent that the response is significant at 10 percent level and the size of the coefficient is smaller. However our main interest being in the sign of response, it is note worthy that the sign remains unaffected.

Table 9.15 shows the feedback relation from domestic credit to exchange market pressure for the main *ordering* used as well as for, alternate *orderings*.

Table: 9.15
Sensitivity to Ordering of variables
Shock to: Exchange Market pressure
Impact upon: Innovation to domestic credit

| Period | Ordering Used *dc-i-y-emp* | Alternate Orderings | | |
|---|---|---|---|---|
| | | *dc-i-emp-y* | *dc-emp-i-y* | *emp-dc-i-y* |
| I[st] | | | | 3.86 (5.53) |
| 5[th] | 1.17 (2.16) | 1.33 (2.41) | 1.48 (2.65) | |

Note: t-statistics in parenthesis

The results pertaining to feedback relation from exchange market pressure to domestic credit are also sensitive to the *ordering* [*emp-dc-i-y*] that places $emp_t$ before $dc_t$. However the results are effected only in respect of size of the coefficients, the direction of the response remains unchanged.

Table 9.16 shows the impact of interest rate upon exchange market pressure for the main *ordering* used as well as for, alternate *orderings*.

Table: 9.16
Sensitivity to Ordering of variables
Shock to: Innovation to interest rate
Impact upon: Exchange Market pressure

| Period | Ordering Used *dc-i-y-emp* | Alternate Orderings | | |
|---|---|---|---|---|
| | | *dc-i-emp-y* | *dc-emp-i-y* | *emp-dc-i-y* |
| Ist | 0.43 (2.28) | 0.43 (2.28) | 0.27 (1.42) | |
| | | | | 0.27 (1.41) |

Note: t-statistics in parenthesis

It is apparent from Table 9.16 the results regarding the impact of interest rate upon exchange market pressure are insensitive to all four alternate *orderings* examined.

Table 9.17 shows the feedback relation from exchange market pressure to interest rate for the main *ordering* used as well as for, alternate *orderings*.

Table: 9.17
Sensitivity to Ordering of variables
Shock to: Exchange Market pressure
Impact upon: Interest rate

| Period | Ordering Used *dc-i-y-emp* | Alternate Orderings | | |
|---|---|---|---|---|
| | | *dc-i-emp-y* | *dc-emp-i-y* | *emp-dc-i-y* |
| Ist | | | 0.10<br>(2.28) | 0.11<br>(2.60) |
| 2nd | 0.13<br>(3.70) | 0.14<br>(3.88) | 0.16<br>(4.23) | 0.16<br>(4.13) |
| 3rd | | | 0.08<br>(2.16) | 0.09<br>(2.39) |
| 5th | 0.08<br>(2.26) | 0.07<br>(2.08) | | 0.10<br>(2.63) |

Note: t-statistics in parenthesis

Table 9.17 shows that the results produced under the *ordering* used are sensitive the *orderings* that place $emp_t$ at the first and second place in terms of number of significant responses. However the size and sign of the coefficients remain (by and large) unaffected.

**9.5 Variance Decomposition**

Variance decomposition provides a different method of analyzing the results of VAR system. While impulse response functions trace the effects of a shock to an endogenous variable on the variables in the VAR, variance decomposition, by contrast, decomposes variation in an endogenous variable into the component shocks to the endogenous variables in the VAR. Thus variance decomposition provides information about the relative importance of each random innovation to the variables in the VAR.

Variance decomposition results, for the full span as well as the sub spans, are summarized (i.e. first and last period of the forecast horizon) in table 9.18. The results show the degree to which the forecast error variance of exchange market pressure is explained by the two monetary variables *viz*. domestic credit and interest rate. The following is evident from the analysis of results.

Table 9.18
Variance Decomposition

| Period | Full | | FCD | | | | Post FCD freeze/post 9/11 | | Post 9/11 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Dc* | *i* | *dc* | *I* | *Dc* | *i* | *dc* | *i* | *dc* | *i* |
| ist | 17.73 | 2.71 | 48.96 | 5.38 | 15.97 | 0.57 | 26.78 | 0.03 | 12.60 | 11.11 |
| 24th | 18.05 | 4.29 | 48.22 | 6.53 | 16.14 | 4.41 | 31.69 | 0.73 | 31.69 | 16.56 |

Note: The figures reflect the percentage variance attributed to the variable

Though the percentage composition of a shock to the forecast error variance of exchange market pressure varies from span to span, one key message is apparent from the results. The result show that in all the spans examined, a greater part of the variance is explained by domestic credit relative to interest rate. This confirms the point that domestic credit has remained the dominant tool of monetary policy.

**9.6 Granger Causality:**

Granger Causality tests have been conducted using exactly the same multivariate equations as are included in the VAR estimation of the exchange market pressure model, given by equation (5.44). For example to test the hypothesis: 'domestic credit causes exchange market pressure' for the full span (91:04-05:12) the equation used is:

$$emp_t = dc_{t-j} + i_{t-j} + y_{t-j} + emp_{t-j} + z_t + \pi_t^* \qquad 9.1$$

Where $j$ is the number of lags[34]. To estimate Granger Causality, the same lag order has been used as employed for estimation of the VAR system. The lag order has been shown earlier in table 9.2.

Granger Causality tests (F-test) result are reported below in table 9.19.

Table: 9.19
Granger Causality test: Results

| Null Hypothesis | Full: 91:04-05:12 | FCD: 91:04-98:05 | OMOs Initiation 95-05 | FCD-Freeze 98-05 | 9/11 01:10-05:12 |
|---|---|---|---|---|---|
| $dc_t$ causes $emp_t$ | no (1.37) | no (0.74) | no (0.31) | **yes (2.40)** | **yes (3.87)** |
| $emp_t$ causes $dc_t$ | no (0.87) | No (1.86) | no (0.69) | no (1.10) | no (0.66) |
| $i_t$ causes $emp_t$ | no (0.79) | no (0.48) | no (1.35) | no (1.10) | **yes (2.11)** |
| $emp_t$ causes $i_t$ | **yes (4.03)** | **yes (2.48)** | yes (3.25) | no (0.21) | no (0.51) |

F-statistics in parenthesis

### 9.6.1 Causality from Domestic Credit to Exchange Rate:[35]

As evident from table 9.20 the test results show that domestic credit causes exchange market pressure in the Granger-sense only in the post FCD freeze and post 9/11 span. The causality from domestic credit to exchange market pressure observed during the two spans implies that volume of domestic credit has at least partially been determined by the level of upcoming magnitude of exchange market pressure. In other words monetary policy has been influenced by exchange market pressure considerations. An evidence of this is the intervention activity of the central bank in the forex market during the last few years of the data span. The exact year-wise volume of intervention during these years is indicated below in table 9.20

Table 9.20
Purchase/Sale of Foreign currency by SBP
(million US Dollars)

| Period | Interbank (net) | Kerb Purchases | Net Addition FR* |
|---|---|---|---|
| 1999-2000 | -797.0** | 1633.4 | 836.4 |
| 2000-2001 | -1125.6** | 2157.3 | 1031.7 |
| 2001-2002 | 2483.0 | 1375.7 | 3858.7 |
| 2002-2003 | 4546.0 | 429.3 | 4975.3 |
| 2003-2004 | 896.8 | 0.00 | 896.8 |

* FR stands for foreign reserves.**The negative sign with the figures indicates sale of foreign currency
Source SBP annual reports (various reports)

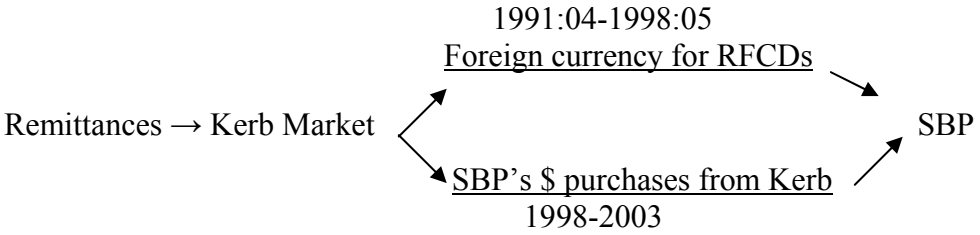
The intervention activity for the period 1999-00 to 03-04 can be separated into two sub-periods with opposing exchange market pressure scene. The objectives of intervention in the two periods are discussed below.

The first period, starting with May 1998 reflects the period when economic-aid sanctions were imposed on Pakistan in the wake of going Nuclear then. The foreign reserves held by the central bank at that time amounted to $1.28 billion. We have discussed earlier that the foreign currency deposits mobilized by the commercial banks were surrendered to SBP, therefore the foreign reserves of the central bank were a natural hedge against default on foreign currency deposits. Upon imposition of sanctions in May

[34] The variables have been defined earlier in chapter 4 under theoretical framework.
[35] Before we discuss the results from Granger causality test it is important to emphasize that Granger causality does not essentially imply economic causality (Hamilton, 1994). For example expectations of changes in reserves could cause domestic credit to change. This would cause domestic credit to change today, so that the Granger causality would seem to run from domestic credit to reserves but the true causality goes from expectations of reserves to domestic credit,

1998, with foreign reserves at a rather low level and prospects of improvement in foreign reserves being rather dim, due to aid sanctions, it was but logical for the people to expect that the government/SBP will not be able to fulfill its obligation regarding the redemption of FCDs.

In the light of the above, the government feared a run on foreign currency deposits. To cope with the situation the government imposed a freeze on foreign currency deposits. The foreign currency account holders were allowed to withdraw only Rupee equivalent of the foreign currency held in their accounts. The default on the part of the government, to redeem FCDs in foreign currency besides shattering the confidence of the depositors had an adverse impact on foreign investment as well. The following flowchart (given in chapter 8, indicates the mechanics as to how remittances at different times had fed the foreign reserves. The flowchart is reproduced here for the convenience of the reader.




The flowchart given above shows that FCDs were merely a channel of transferring remittances from the kerb market to the SBP. The freeze on FCDs closed the channel for such transfer. The premium between kerb market exchange rate and the official exchange rate being still high the inflow of remittances through formal banking channel was not expected then (i.e. May 1998). Under the given scenario the central bank purchased foreign currency, in exchange for domestic currency, from the kerb /inter bank market in 99-00 and 00-01 to bolster its depleted reserves. The purchase obviously resulted in expansion of domestic credit. This shows that the increment in reserves, resulting from expansion in domestic credit, relieved the exchange market pressure. Thus exchange market pressure consideration led to expansion in domestic credit or in other words monetary policy became subordinate to external account situation.

The intervention activity undertaken post 9/11 was in an entirely different backdrop. After 9/11 the exchange market pressure in Pakistan improved dramatically. The substantial improvement in exchange market pressure was mainly due to three

reasons: (i) increase in remittances from overseas Pakistanis, (ii) Reprofiling/waiver of foreign loans and (iii) some improvement in macroeconomic fundamentals. How the forgoing affected an improvement in exchange market pressure has been discussed at length in Chapter 8 (EMP-Key influences). Table 9.21 gives an idea about the extent of improvement.

Table 9.21
Exchange rate appreciation & increase in Foreign Reserves

| | Sept. 2001 | Dec. 2003 | Appreciation/Increase |
|---|---|---|---|
| Exchange Rate | RS. 64.20 | RS. 57.21 | 12 percent |
| Foreign Reserves | $2,149 | $10,941 | 409 percent |

In just two months since 9/11 the exchange rate had appreciated by 5.2 percent and the foreign reserves had registered an improvement of almost 50 percent over the figure just prior to 9/11. The appreciation of exchange rate was hurting the export competitiveness of the country. Given this the authorities decided to stall/slowdown the appreciation of exchange rate. Consequently the central bank purchased foreign currency to the tune of $9.7 billion from July 01- June 04 (Table: 9.21), from the interbank as well as the kerb market, in exchange for domestic currency, thereby increasing domestic credit. Thus once again domestic credit was used to manage exchange market pressure. This time, to stall the appreciation of exchange rate rather than manage an increase in foreign reserves. The foregoing discussion shows that, domestic credit was extensively used to manage exchange market pressure. The following statement included in SBP annual report confirms the point.

> Over the last few years, while monetary policy gained a degree of independence from fiscal policy, it remained captive to the exchange rate considerations. Interestingly, these shackles persisted through the whole of FY02 despite the current account surpluses seen post-September 2001, which led to a considerable appreciation of the Rupee. However, the focus changed dramatically during the year as the emphasis shifted from preventing a *depreciation* of the Rupee, to avoiding a very abrupt *appreciation* (SBP annual report: 2001-02).

The fact that the causality discussed above is observed from domestic credit to exchange market pressure and not the other way round implies that the central bank followed a proactive policy monetary policy that is in anticipation of the expected level

of exchange market pressure the central bank changed the level of domestic credit to manage exchange market pressure.

### 9.6.2 Causality from Exchange Market Pressure to Interest Rate

The foregoing analysis explains the causality observed from domestic credit to exchange market pressure in the post FCD-freeze and Post 9/11 span. Now we take up the causality observed from exchange market pressure to interest rate during the three spans *viz*. Full span, FCD-span and post monetary policy liberalization span (OMO initiation).

For the interest rate channel to work some avenue is needed through which foreign funds may flow. Foreign currency accounts had been the said avenue during the period 1991:04 to 1998:06. With the freeze on foreign currency accounts in May 1998 the avenue stood closed and hence the absence of causality from exchange market pressure to interest rate for spans that encompass post FCDs-freeze. To substantiate our point we present a comparison of yield on FCDs and deposits denominated in domestic currency in table 9.22.

Table 9.22
Yield Comparison: FCDs and Domestic Deposits

| Year | (1)* Avg. rate paid by banks on FCDs | (2) Exchange rate Depreciation | (3)=(1)+(2) Yield on FCDs* | (4)* Weighted avg. rate on Deposits in domestic currency | (5) T.Bill rate (6 months) |
|---|---|---|---|---|---|
| 91-92 | 6.0 | 3.42 | 9.42 | 7.59 | 12.22 |
| 92-93 | 6.0 | 8.08 | 14.08 | 7.70 | 12.43 |
| 93-94 | 6.0 | 12.70 | 18.70 | 8.04 | 10.96 |
| 94-95 | 6.0 | 1.31 | 9.31 | 8.18 | 12.73 |
| 95-96 | 6.0 | 13.19 | 19.19 | 8.24 | 13.03 |
| 96-97 | 6.0 | 15.27 | 21.27 | 8.49 | 16.05 |
| 97-98 | 6.0 | 13.69 | 19.69 | 8.38 | 15.70 |

* SBP annual report 97-98 p.116

** SBP statistical handbook

Note: The average rate on Defense Savings Certificate (DSC) was 13.8% however this includes the rate on DSCs of longer term maturity (5-10 years) whereas the FCDs were mainly of short-term maturity.

The data in table 9.22 shows that yield on FCDs was always above the weighted average rate paid on deposits denominated in local currency and was also more often greater than average return on Defence Savings Certificates—the highest yield securities denominated in local currency. To make the comparison between returns on FCDs and

domestic instruments more meaningful two things are note worthy. One; the actual yield on FCDs would be more than that shown in the table because usually the residents would purchase foreign currency for holding FCDs from the kerb market. As the kerb market exchange rate was always at a premium over the official rate and the premium generally exhibited an increasing trend since 1994[36] therefore the increment in kerb market premium during the tenor in which the FCDs were held by a depositor would also constitute yield for him. Second; unlike FCDs domestic instruments were subjected to taxes and Zakat deductions. Accounting for such deduction would make the return on domestic instrument lesser than that shown in the table 9.22.

From 1991 to 1998, the exchange market pressure had generally been positive and relatively higher, during this period the interest rate had also exhibited a rising trend. The causality from exchange market pressure to interest rate leads us to infer that during the years the authorities used the interest rate to defend the Rupee. Remittances from overseas workers after having reached a peak of $2.8 billion in 1982 had started tapering-off. To cope with the shortage of foreign currency the government allowed the residents to hold foreign currency accounts. The yield on FCDs being higher than the deposits denominated in domestic currency, there was trend among residents to hold their savings as FCDs for which the foreign currency was being purchased from the kerb market. It is noteworthy here that during the FCD-span, the non-resident FCDs that were allowed in 1991 stood at $6.9 billions (Table 8.7) at the time of freeze in 1998. The dollarization, in this manner, increased the demand for foreign currency in the kerb market and there by led to the depreciation of Rupee. Depreciation of exchange rate, as is known, makes the imported goods costlier and increases the value of foreign debt in domestic currency. Therefore to avoid importing inflation the SBP had to defend the Rupee by increasing the return (interest rate) on domestic assets (Mirakhor and Zaidi, 2006). Thus the exchange rate depreciation, a component of exchange market pressure, led to increase in interest rate. This explains the Granger causality from exchange market pressure to interest rate during the FCD span. The impact of the causality observed in the FCD span (a sub-span) is strong enough so as to make it observable in the full span as well.

[36] SBP annual report 97-98, p.131.

### 9.6.3 Causality from Interest Rate to Exchange Market Pressure

Causality from interest rate to exchange market pressure is observed in the post 9/11 span. 9/11, for reasons outlined earlier, had a favourable impact upon the exchange market pressure, at least, in the immediate future. Post 9/11, the external account position improved dramatically; the foreign reserves registered a quantum jump and the exchange rate was on an appreciation for the first time in Pakistan's history. Given the exchange rate appreciation and the comfortable foreign reserves position the need to defend the Rupee was no longer there. Therefore the central bank could afford to practice a loose monetary policy, which otherwise was also required to give a much needed boost to the economy, and this is what the central bank actually did, as the interest on 6-months treasury bills declined by 929 basis points in 22 months (Oct. 01-July 03). Thus the improvement in exchange market pressure led to the decline in interest rate. This point of view is supported by the following excerpt from SBP annual report:

> The continued forex inflows coupled with low inflationary pressures during FY03 allowed, the SBP to reduce the discount rate to an all-time low at 7.5 percent in November 2002. This led to a lowering of lending rates. (SBP Annual report: 2002-03 p.147).

Given this we should have observed the causality from exchange market pressure to interest rate in the post 9/11 span, however, in practice the causality observed is the other way round. The reason lies in the fact that the post 9/11 span encompasses a period of 52 months in total out which the interest rate was on a downward course for the initial 22 months only. For the remaining 30 months (Aug.03-Dec.05), interest rate followed an upward path and the exchange rate after ending the appreciation spell in December 2003 was on the depreciation course for remaining 24 months of the post 9/11 data span. Thus it was the upcoming pressure on exchange rate that forced the SBP to raise interest rate − to defend the Rupee. This suggests that we should be able to observe causality from interest rate to exchange market pressure in the post 9/11 span, as in practice is the case. Having described above the possibility of causality in two opposing directions, the fact that the ultimately the causality observed during the post 9/11 span is from interest rate to exchange market pressure and not the other way round implies that that the depreciation pressure on exchange rate since January 2004 outweighed the positive effect of exchange

rate appreciation during the earlier part of the span so that the ultimate causality observed, during, the span is from interest rate to exchange market pressure.

Before we close the discussion on causality from interest rate to exchange market pressure, we would like to note a caveat here. The analysis given above assumes that inflation is a purely monetary phenomenon. We have noted in section 2.4 that evidence for Pakistan on this count is mixed. To recap we may mention that Khan and Schimmelpfennig (2006), Qayyum (2006) and Kemal (2006) validate the monetarist hypothesis. On the other hand Naqvi *et al*. (1994), Khan and Qasim (1996) Bilquees (1988) while accepting money to be an important determinant of inflation, note that supply side factors have also contributed to inflayion in Pakistan. Pasha *et al*.(1995) find that procurement prices, especially that of wheat and administered prices of fuel, gas and electricity have been the key determinant of inflation in Pakistan. The authors do not find a significant role of demand management policies or supply shocks in explaining inflation in Pakistan. Bilquees (1988) notes that superiority of either the monetarist or structuralist cannot be established. Given the conflicting evidence, we would like to caution the reader the while reading through the analysis referred above the caveat that besides monetary factors other factors also have a role in determining inflation in Pakistan should be borne in mind.

**9.7 Monetary Autonomy**

Monetary autonomy, as mentioned earlier, is the authority's ability to determine the level of money supply independently. Theoretically, *cetrius peribus*, under fixed exchange rate regime money supply being endogenous, monetary independence does not exist while under flexible exchange rate regime money supply being exogenous, there is complete monetary independence. (Empirically this may not be true). Managed float being a mixture of fixed and flexible exchange rate regimes, monetary independence lies somewhere between two extremes of complete independence and no independence at all.

When exchange market pressure builds up the authority decides to curb such pressure by using domestic credit, interest rate or some combination of the two. However the success of the policy adopted depends upon the degree of monetary autonomy enjoyed by the authority. With low independence the monetary instruments have to be

used more vigorously for them to have the desired impact upon exchange market pressure. For high independence the converse is true (Kamaly and Erbil, 2000). Given this, it becomes important to determine the exact degree of monetary independence enjoyed by the Authority.

Exchange Market Pressure, being the sum of the elements that makes the money supply endogenous or exogenous, affords an opportunity to measure the exact degree of monetary independence enjoyed by the authority. The measurement of the degree of monetary autonomy is discussed below.

Co-efficient of variation (standard deviation / mean) for the reserve and exchange rate series allows us to measure the degree of monetary autonomy. Greater the changes in a series; higher is its coefficient of variation. Under fixed exchange rate regime the authority keeps the change in exchange rate at zero while under floating exchange rate regime the changes in reserves are kept at zero. Managed float allows adjustments in exchange rate as well as foreign reserves. Therefore dominance of exchange rate changes (higher coefficient of variation) implies a relatively higher degree of monetary autonomy and vice versa.

Coefficient of variation has been worked out for the two series *viz*. exchange rate and foreign reserves. The series' used to compute the coefficient of variation are the same as employed to work out the exchange market pressure, that is, the exchange rate change is expressed as percentage growth while the foreign reserves (Rupee value) are scaled by monetary base. The coefficient of variation has been computed for the full data span as well as various sub spans. The motivation for using various sub-spans is that each sub-span reflects some event of importance in the context of monetary autonomy. The importance of each span is described below in table 9.23.

Table: 9.23
Data spans for measuring the Degree of Monetary Autonomy

| **Span** | **Peculiarity of the span** |
|---|---|
| 1982-2005 | Full data span: Period of managed float |
| 1991:04-1998:05 | Life of Foreign Currency Accounts (FCAs) that facilitated inward capital mobility and thereby influenced exchange market pressure. |
| 1995-2005 | Sale/Purchase of Treasury bills initiated through Open Market Operation (OMO) |
| 1998:05-2005:12 | Foreign currency accounts were freezed on May 28,1998 and official exchange rate was kept fixed at RS. 46: $1 for the next eleven months. During the period Open market rate went way off the official exchange rate. |
| 1999:03-2005:12 | Floating interbank exchange rate, determined on the basis of demand and supply in the interbank market, is adopted as the official exchange rate. SBP stops announcing official exchange rate. |
| 2001:09-2005-12 | Exchange market pressure eases following 9/11. |

### 9.6.1 Coefficient of variation: Result

Coefficient of variation, for Exchange rate and Foreign Reserves, for the full data span as well as various sub spans, are reported below in Table 19.24

**Table: 9.24**
Coefficient of Variation
Exchange Rate vs. Reserves
Series

| Span | Exchange Rate | Foreign Reserves |
|---|---|---|
| 1982-2005 (Full Span) | 0.51 | 6.55 |
| 1991:04-1998:05 | 0.30 | 4.70 |
| 1995-2005 | 0.20 | 5.05 |
| 1998:06-2005:12 | 0.09 | 2.92 |
| 1999:05-2005:12 | 0.07 | 2.66 |
| 2001:09-2005-12 | 0.02 | 1.99 |

Coefficient of variation for exchange rate series from 1982:01-2005:12 is 0.51 while for foreign reserves (Rupee value) series it is 6.55. The coefficient for foreign reserves series retains its dominant position in all the sub spans examined. The coefficient for foreign reserves series being sufficiently higher than the one for exchange rate series implies that Pakistan enjoyed quite low degree of monetary autonomy, during the period

under review. In other words, tilt of the managed float has in essence been towards the fixed regime rather than towards fixed exchange rate regime.

The lower degree of monetary autonomy noticed here helps to explain why domestic credit rather than interest rate is the dominant tool of monetary policy, as evidenced by IRF's and Granger causality (section 9.3 and 9.5). Generally, the interest rate instrument is associated with the market based management of monetary policy and so is the floating exchange rate regime. On the other hand the use of domestic credit and fixed exchange rate regime both are associated with regulated management of monetary policy. Both the lesser degree of monetary autonomy, implying tilt toward fixed exchange rate regime and the dominance of domestic credit relative to interest rate as tool of monetary policy point towards the same fact; monetary management has been more regulated and less market based.

Though credit ceiling for banks have been abolished, limit on maximum lending rates have been removed and except for National banks all banks stand privatized, private banks have been allowed to enter the market and OMOs are now the major instrument of monetary policy, the objective of shift in monetary regime has not been achieved. Interest rate for all practical purpose is still controlled by the SBP. The power of the SBP to arbitrarily reject bids in T.Bill auctions and decide the cut off yield on its own makes the change in regime more of a ritual. It is because of this regulated nature of monetary policy that interest rates were rather slow to respond to the rising trend of inflation in 2003-04 and then to the surge in inflation from 4.6 percent in 2003-04 to 9.3 percent in 2004-05. It is note worthy that during the period real interest rate remained negative. (Table 7.5 that shows the trend of inflation and interest rates in recent years is reproduced here for the convenience of the reader).

Table 7.5
Growth, inflation and interest rates

| Year | GDP Growth | Inflation | T.Bill rate |
|---|---|---|---|
| 02-03 | 4.8 | 3.1 | 1.66 |
| 03-04 | 7.5 | 4.6 | 2.31 |
| 04-05 | 8.6 | 9.3 | 7.96 |

# 10 Summary and Conclusions

The idea of the study stems from the fact that under the managed float exchange rate regime, changes in foreign reserves or changes in exchange rate in isolation are not a sufficient guide to characterize the external account situation of an economy. For example, exchange rate depreciation can be partially avoided or at least delayed if the central bank injects foreign currency in the forex market by letting its foreign reserves deplete. Alternatively, central bank can build up foreign reserves by purchasing foreign currency from the market against domestic currency. Such intervention would curb the exchange rate appreciation demanded by fundamentals. Therefore focus on either of the two, that is, movement in exchange rate or variation in foreign reserves, to the complete exclusion of the other, is bound to portray a misleading picture of the external account situation. Given the foregoing a composite variable, that incorporates changes in exchange rate as well as variation in foreign reserves, over a certain period, is needed to characterize the condition of external account. Exchange market pressure is that composite variable.

The seminal work on exchange market pressure is of Girton and Roper (1977). They define exchange market pressure as the simple sum of percentage depreciation in exchange rate and changes in foreign reserves scaled by monetary base.

The objectives of this study, which is exclusively focused on Pakistan, were:

(i) analysis of the nature of relationship between exchange market pressure and monetary variables viz. domestic credit and interest rate;

(ii) identification of the monetary tool(s) used to manage exchange market pressure; and

(iii) Monetary autonomy enjoyed by State Bank of Pakistan (SBP).

The main contribution of the study is that so far exchange market pressure has not been studied as a composite variable for Pakistan. In May 1999 free float exchange rate regime was introduced in the country. With the introduction of the regime, SBP stopped the practice of announcing official rate, and the exchange rate prevalent in the inter bank market is now accepted as the official rate for all transactions. Since then, SBP has been more frequently intervening in the forex market. For example, just after 9/11, within one

year the exchange rate appreciated by 8 percent and the foreign reserves registered an increase of 171 percent. During the period the central bank purchased around $4.0 billion from the forex which roughly equals the amount of increase in foreign reserves during the same period. It is widely believed that had the central bank not intervened in the forex market the appreciation of exchange rate would have been much more than the actual 8 percent observed during the year and the appreciation would have been more abrupt. In this case a focus on the exchange rate alone would give a different picture of external account, than that portrayed by the combined variation in exchange rate and reserves. Similarly to stall the depreciation of exchange rate the central bank has been providing foreign exchange from its reserves for oil imports. Again a focus at exchange rate alone would yield a different picture than the one portrayed by combined variation in exchange rate and foreign reserves. The stability of exchange rate, during the past few years, has been achieved at the cost of either the increment in or depletion of foreign reserves. Given the SBP's frequent intervention in the forex market it becomes all the more important to study exchange market pressure as a composite variable that incorporate changes in exchange rate as well as changes in foreign reserves.

The model, that this study uses, improves upon Girton and Roper (1977) in the sense that whereas their model uses only domestic credit as explanatory variable, this study allows for interest rate changes as well to influence exchange market pressure. The motivation for inclusion of interest rate is that in the context of market based management of monetary policy, that now seems to be the norm, the interest rate is the main, if not the only tool of monetary management. However this improvement has been affected by Tanner (2001). Other changes are: unlike forerunners, change in real income is allowed to influence exchange market pressure. Tanner (2001, 2002) and Kamaly & Erbil (2000) have either included or at least recognized the need to include real income as an explanatory variable in their theoretical framework but their data frequency being monthly, they have refrained from use of real income in empirical investigation on the ground of data availability. This study also uses monthly data but has incorporated real income as an explanatory variable by using industrial production as its proxy. The use of the proxy is well established.

A few forerunners have included deviation from purchasing power parity in their theoretical framework but at estimation stage they have assumed that purchasing power parity holds, that is the deviations from PPP are zero. However Wohar and Lee (1992) and Kamaly & Erbil (2000) do not make this assumption. Given the abundant but conflicting evidence on PPP, we rather than relying on the assumption that PPP holds, include the deviation from it in our theoretical framework as well as empirical investigation.

An econometric issue in earlier studies was of simultaneity bias. Single equation models, that these earlier studies have used, are not appropriate for estimation if there exists a two-way relationship between the dependent and independent variable. This study, like Tanner (2001, 2002) and Kamaly & Erbil (2002) uses vector autoregression that, to some extent tackles the simultaneity problem by regressing each variable only on the lags of all the endogenous variables.

One objective of the study was to empirically find out as to what monetary tool(s) are used by SBP for managing exchange market pressure. The results imply that domestic credit has remained the main tool of monetary policy for managing the level of exchange market pressure. First, the impulse response functions depict a relatively weaker relationship (based upon size of the coefficients) between interest rate and exchange market pressure as compared to the relationship between domestic credit and exchange market pressure. Second, regarding the impact of interest rate upon exchange market pressure, of the five data spans examined no significant response (IRF) is noticeable in the span 98-05 and the response observed during the span 95-03 is significant only at 10 percent level. Besides the explanation for the observed relationship between interest rate and exchange market pressure revolves around the FCDs which after the freeze of 1998 had lost their biting force.

Besides Granger Causality from domestic credit to exchange market pressure is observable in the post FCD span and post 9/11 span. Correspondingly, Granger Causality from exchange market pressure to interest rate is observable only during the FCD span and the Full span. (The causality observed in the full span is perhaps due to the overriding influence of the FCD span).

The foregoing econometric evidence leads us to the conclude that, accept for the FCD span of seven and a half years, out of the total span of slightly more than 14 years, domestic credit has remained the dominant tool of monetary policy for managing the level of exchange market pressure. This is understandable, because for the interest rate instrument to work some degree of capital mobility is called for. FCD had provided limited degree of inward capital mobility and with the freeze on foreign currency accounts even the limited inward capital mobility available received a severe dent. The non-use of the interest rate instrument for managing the level of exchange market pressure, in spans other than the FCD span, is due to the lack of capital mobility, a prerequisite for the use of this instrument.

A look at the intervention activity of the central bank from July 1999-June 2004 shows that the central bank purchased a whooping sum of $11.6 billion from inter bank/Open market. This obviously had a very favourable impact upon foreign reserves but at the cost of increase in domestic credit in the economy. Since November 2004 the central bank is providing foreign currency to foot the oil import bill which averages around $5.0- per year. The objective is to stabilize the exchange rate. The fact that the exchange rate been hovering around $60 since November 2004, shows that the stability has been achieved by intervening in the forex market. This has happened when the exchange rate regime is stated to be free float and the rate is supposed to be determined by market forces. This leads us to infer that domestic credit rather than interest rate has been more frequently used to manage the level of exchange market pressure.

Another objective of the study was to examine the degree of monetary autonomy enjoyed by SBP. This has been examined by comparing the coefficient of variation of exchange rate and foreign reserves series. The results indicate that Pakistan has enjoyed quite low degree of monetary autonomy during the period 1991:03-2005:12 and various other sub spans examined. This also explains why domestic credit has remained the dominant tool of monetary policy. The lower degree of monetary autonomy is consistent with tilt of the exchange rate regime towards fixed. The fixed exchange rate regime requires frequent interventions in forex market which in turn calls for the use of domestic credit as the tool of monetary policy.

Finally an important objective of the study was to examine the nature of relationship that monetary variables, *viz*. domestic credit and interest rate, enjoy with exchange market pressure. The methodology employed to examine the relationship includes; (i) Impulse response functions (IRF's) generated by estimation of unrestricted VAR and the Granger causality test. IRF's reveals a positive impact of changes in domestic credit as well interest rate upon exchange market pressure. The responses are as hypothesized. However the relationship between interest rate and exchange market pressure is relatively much weaker than the one that exists between domestic credit and exchange market pressure.

Feedback from exchange market pressure to domestic credit is positive in all the five data spans examined. The response, though against conventional wisdom, is in conformity with similar literature. Exchange market pressure being primarily due to excess supply of money, prudence requires that authorities when faced with exchange market pressure should contract domestic credit to curb the pressure. The apparent reason for the imprudent response lies in monetary policy being influenced by fiscal needs. Fiscal needs seem to have restrained the monetary authorities, in Pakistan, from contracting domestic credit when the need to curb exchange market pressure demanded this.

Besides the level of non-performing loans of the banking sector, in Pakistan and restructuring exercises undertaken in the hope rehabilitating the sick projects, without any reduction in the level of non-performing loans suggest that additional credit provided under restructuring exercises has been a case of putting good money after bad money, leading to increase in money supply when in fact there was a need to contract it.

Additionally non-repayment of loans-due creates a liquidity crunch and thus constrains the ability of banks to make fresh loans. The SBP, in order to keep up the growth momentum, may have responded by providing additional liquidity to the banking system. Hence the unconventional positive feedback from exchange market pressure to domestic credit.

The impact of shock to interest rate on exchange market pressure is positive, in all but one, data spans examined. No significant response is observed in the data span: 98-05. The positive influence of interest rate on exchange market, in the FCD span: 91:04-

98:05 coupled with absence of response during the span 98-05 leads us to conclude that main driving force that had generated the positive response were the foreign currency deposits (FCDs). The increase in interest rate would reduce money demand that in turn would cause depreciation of exchange rate. The depreciation being part of the yield on FCDs, would encourage mobilization of FCDs.

FCDs had two opposing impacts upon the level of exchange market pressure. On the one hand these alleviated exchange market pressure by contributing more foreign currency to foreign reserves on the other hand these exacerbated exchange market pressure by contributing to exchange rate depreciation. What is observable is, of course, the net impact. The positive impact of interest rate (that generally increased) during 91-98, upon exchange market pressure, suggests that the contribution, that the FCDs made to foreign reserves and therefore to the decrease in exchange market pressure has been more than offset by the contribution, that the FCDs made to exchange rate depreciation. This caused the exchange market pressure to increase.

Feedback relation from exchange market pressure to interest rate is positive and significant in all five data spans examined. The response is in accordance with the theory and implies that during the periods in which exchange rate was depreciating; the interest rate was used to defend the Rupee. While in periods when the exchange rate was on an appreciation course, the need for defending the Rupee being not there, a decline in interest was allowed.

The positive feedback from exchange market pressure upon interest rate observed in the spans 91-98 and 95-05 is owed to dollarization phenomenon that had its roots in the introduction of FCDs. The dollarization was contributing to exchange rate depreciation that in turn meant importing inflation. To control inflation the return on domestic securities had to be increased to restrain excessive switch-off from deposits denominated in local currency into foreign currency deposits and thus curb the dollarization phenomenon that was contributing to inflation.

The positive feedback from exchange market pressure to interest rate during the post FCD span and the post 9/11 span is accounted for in the following manner. With the freeze on FCDs the exchange market pressure remained relatively low due to quantitative restriction on imports and an end to with the freeze on FCDs. Given an end

to dollarization the need to defend the rupee vanished. Besides, certain developments rooted in 9/11 changed the very complexion of Pakistan's external account situation. For the first time in Pakistan's history open market exchange rate was on an appreciation course. The rate registered an improvement of 10.9 percent from September 2001 to December 2003 and foreign reserves recorded an increment of $8.8 billion (409 percent) during the period. Purchases of foreign currency from the kerb market to smoothen the appreciation of exchange rate, increase in remittances through official channel due to collapse of the kerb market premium and strict international watch on informal channels, write-offs, restructuring of foreign loans, fresh foreign inflows on account of foreign loans and grants due to improved relation with international lenders, together contributed towards dramatic improvement in external account situation of Pakistan.

As the external account situation improved and the exchange market pressure registered an improvement to the extent that it persistently remained in negative zone from October 2001 to December 2003 and therefore the need to defend the Rupee by influencing an upward movement in interest rate, was not there. Thus the decrease in exchange market pressure caused the interest rate to decline.

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Impulse response: Full Span
Comparative Statement: With and Without Structural Dummies*

Dummies have been introduced at 1995:01, 1998:06 and 2001:09, to account for structural changes, due to initiation of OMO's, freeze on foreign currency deposits/aid sanction and 9/11. The structural dummy for 9/11 is statistically significant in the interest rate equation while structural dummy for freeze on foreign currency deposits is significant in the exchange market pressure equation. It is clear from the results presented below that the introduction of the dummies does not materially alter the results so as to affect our analysis.

Table: Anx 1.1
Shock to: Innovation to Domestic Credit
Impact upon: Exchange Market Pressure

| Periods | Without Structural | With Structural Dummies |
|---|---|---|
| 1st | 1.09<br>(5.52) | 1.12<br>(5.80) |

Table Anx 1.2
Shock to: Innovation to Exchange Market Pressure
Impact upon: Domestic Credit

| Periods | Without Structural | With Structural Dummies |
|---|---|---|
| 5th | 1.17<br>(2.16) | 1.21<br>(2.38) |

Table Anx 1.3
Shock to: Innovation to Interest Rate
Impact upon: Exchange Market Pressure

| Periods | Without Structural | With Structural Dummies |
|---|---|---|
| 1st | 0.43<br>(2.28) | 0.44<br>(2.40) |

Table Anx 1.4
Shock to: Innovation to Exchange Market Pressure
Impact upon: Interest Rate

| Periods | Without Structural | With Structural Dummies |
|---|---|---|
| 2nd | 0.13<br>(3.70) | 0.14<br>(4.10) |
| 5th | 0.08<br>(2.26) | 0.10<br>(2.70) |