Foreign exchange intervention and sterilization: an investigation of State Bank of Pakistan's Reaction Function

Waheed, Muhammad

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Abstract

We looked into Pakistan's central bank response to the foreign exchange inflows, for the period from 2001:01 to 2007:06, to strike a balance between competing goals of internal and external equilibriums to draw lessons for its conduct going forward. Using a reaction function we tested the hypothesis that SBP fully sterilized its foreign exchange interventions. The results indicated that for this period, SBP only partially neutralized its foreign exchange interventions. In addition, we also found that changes in SBP's domestic credit were counter cyclical as it had negative relation with the output gap. However, the changes in domestic credit were found to have positive relation with changes in inflation. This probably resulted from too much weight assigned to growth objective in the back drop of recession and low inflation environment at the start of 2001. It was also found that the SBP also change its domestic credit systematically to reduce interest rate variability at the short end.

1.1: Introduction

Since 2000 the emerging economies had experienced a surge in foreign exchange inflows followed by massive interventions by their central banks to prevent currency appreciation [Mohanty and Turner (2005)]. Pakistan was no exception as it also experienced a similar increase in the inflows since 2001. This resulted in reversal of established market expectations of devaluation of currency and accordingly rupee started to appreciate. The relatively huge volume of inflows forced the State Bank of Pakistan (SBP) to intervene in the foreign exchange market to keep the parity between Pak Rupee and US Dollar stable.[1] As a consequence SBP accumulated significant foreign exchange reserves. As a result, ample domestic liquidity was generated. The interest rates fell to historically low levels during 2001 to 2007 and private sector credit grew very rapidly. Real GDP grew, on average, by 5.7 percent during this period. Inflation, which was below 4.0 percent in the period from 2001 to 2005, started to accelerate afterwards but still remained within single digit up till 2008.

However, Pakistan experienced a balance of payment (BOP) crisis and inflation soared to a record level in Fiscal Year (FY)08 and FY09. After adopting a macroeconomic stabilization program, BOP has improved slightly and stabilized. It is expected that in future Pakistan will experience significant foreign exchange inflows due to official pledges by Friends of Democratic Pakistan, pickup in economic activity and improved sentiments of foreign investors towards the country. The conduct of central bank in managing these inflows will determine the macroeconomic stability in medium term. Therefore, it is worth investigating the conduct of monetary policy in years prior to the current BOP crisis when inflows were significant and to see

[1] Since there were large inflows from US and Europe by expat Pakistanis, it was feared that these are one off transfers and as soon as the situation gets better, these inflows would shrink substantially. Therefore to shield the external sector from this perceived volatility in exchange rate, SBP intervened in the market.

what lessons we could draw. Despite many pertinent questions, this paper, however, will narrow its focus to enquire the following issues: was SBP able to isolate its domestic credit from balance of payment consideration through sterilization of its foreign exchange intervention? What policy options could it had? And how was its conduct regarding its competing statutory goal of achieving growth and price stability?

According to impossible trilemma, a country opting for greater financial integration with the rest of the world must give up exchange rate stability if it wishes to preserve monetary independence.[2] Many developing countries adopted the policy of managed float to reduce the exchange rate volatility and to preserve some degree of monetary independence [Aizenman and Glick (2008)]. Central banks can intervene in foreign exchange markets to contain currency appreciation for some time because there is no limit to the volume of domestic currency they can sell in forex markets. There is also a view that significant intervention for extended period shall eventually wane domestic macroeconomic performance presenting the central banks with a policy impasse [Mohanty and Turner (2005)]. This is because of the fact that the intervention in the foreign exchange market complicates the balancing between monetary and exchange rate policies as the situation could arise where the central bank would like to achieve competing goals of resisting currency appreciation and controlling inflationary pressures. If so, injection of liquidity due to foreign exchange interventions could cause difficulties for the conduct of monetary policy.

These interventions in foreign exchange market can be sterilized or nonsterilized. Sterilized intervention occurs when central bank acts to offset the effects of a change in its foreign

[2] The Trilemma states that a country can opt any two of the following three goals simultaneously: monetary independence, exchange rate stability and financial integration.

exchange holdings on the monetary base.[3] Compared to this, nonsterilized intervention occurs when the central bank buy or sell foreign exchange, against domestic currency without such counterbalance actions [Obstfeld and Rogoff (1996)]. There is an agreement in literature that nonsterilized intervention can manipulate the exchange rate in a similar way as monetary policy by inducing changes in the stock of the monetary base which, in turn, induces changes in broader monetary aggregates, interest rates, market expectations and eventually the exchange rate. However, the efficacy of sterilized intervention is very controversial, therefore the debate on the effectiveness of official intervention in the foreign exchange market mostly relates to sterilized intervention [Sarno and Taylor (2001)].

Obstfeld (1982b) observed that if sterilized intervention does influence the exchange rate, then it could be considered as a second policy instrument along with the domestic credit policy, through which monetary authority can simultaneously achieve its internal and external targets in short run. Obstfeld (1982a,b) and Sarno and Taylor (2001) indicated that for the sterilized intervention to succeed in achieving its objective of accomplishing independent external and internal targets; domestic and foreign assets must be imperfect substitutes in the private portfolio.[4]

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[3] Sterilized intervention is a combination of two transactions. First the central bank conducts a non-sterilized intervention by buying foreign currency with home currency. This results in the increase in monetary base. Then the central bank sterilizes the effect on monetary base by selling a corresponding quantity of home currency denominated bonds to soak up the initial increase in the monetary base. [Obstfeld and Rogoff (1996) chapter 8]

[4] This view relates to the portfolio balance theory channel for the effectiveness of sterilized foreign exchange intervention. If domestic and foreign assets are regarded by agents as perfect substitutes, sterilized intervention may have no significant result on the exchange rate. This is because people will be uninterested regarding the relative amounts of domestic and foreign assets, they are holding. They would only care about the total amount and therefore no change in the relative quantities of domestic and foreign assets in their portfolios. Consequently, there will be no change in market clearing prices. And for domestic and foreign assets to be imperfect substitutes; there must be some kind of risk premium.

If so, sterilized intervention in the foreign exchange market should be a preferred way for the central banks to accomplish both its monetary and exchange rate targets. However, Mohanty and Turner (2005) argued that achieving the independent monetary and exchange rate policies goals are only possible when the intervention is small or when it is expected that the situation will reverse quickly.

Given that the SBP intervened heavily in the foreign exchange market, gauging the efficiency of its interventions is a subject of empirical investigation. However, as mentioned earlier the debate on the effectiveness of official intervention in the foreign exchange market mostly relates to sterilized intervention [Sarno and Taylor (2001)], therefore, before such an empirical investigation could be done, we ought to determine whether or not SBP sterilized its interventions and to what extent? So the one objective of this paper is to understand the extent of sterilization of the foreign exchange intervention in the period under study to ascertain the success of SBP in isolating its domestic credit from balance of payment consideration. In addition, we would try to investigate the behavior of the SBP with respect to various objectives of its monetary policy. For instance, SBP's statutory mandate requires it to formulate policies which should focus on growth and price stability. Malik and Ahmed (2007) investigated SBP's monetary policy reaction function by considering short end interest rate as an operational target and found that in addition to these two objective of price stability and growth, the SBP also focused on short run interest rate smoothing as an objective in its reaction function. However, many SBP publications have identified that instead of short end interest rates, SBP had been targeting the monetary aggregates as an operational target.

Therefore, to investigate these questions empirically, a reaction function is developed in terms of domestic credit as an operational target. The estimation of the reaction function was done using

generalized method of moments (GMM) technique for the monthly data for the period 2001:1 to 2007:06. This technique is selected so as to take in to account the endogeneity problem between the changes in domestic credit and the various arguments of the reaction function such as the changes in foreign reserves, inflation and interest rate smoothing.

1.2: Monetary and exchange rate policies in historical perspective:

Nineties was a difficult decade for Pakistan economy. Economic growth slowed down due to various factors namely: political uncertainties, weather calamities and structural constraints. This situation further deteriorated in late nineties when Pakistan went nuclear and attracted economic sanctions from the international community. However, it was the external sector of the economy that suffered the most. The significant foreign exchange inflows of 1980s dried down after the end of Afghan war against the former USSR. That put the economic system of the country under severe strain. In the mean time, rising current account deficit that resulted from increase in domestic absorption and loss of competitiveness caused fall in international reserves. Consequently, the central bank was forced to frequently devalue domestic currency during nineties in order to correct current account imbalances (see Annex **Table 1.A** for selected economic indicators). [5]

After enduring a painful decade of low growth and contractionary demand management policies, Pakistan's economic performance started to improve after 2000. Fiscal deficit was contained within the so called sustainable limit, inflation was low, and there was steady accumulation of foreign exchange reserves. In short, macroeconomic fundamentals were generally back on track. As part of stabilization program, Pakistan's central bank allowed a free float for its currency and dismantled the Rupee band that had been in place during FY00. As a result, rupee depreciated

[5] For details, see Janjua (2004), History of The State Bank of Pakistan 1988-2003 Chapter 7 for more details.

by 23.8 percent during the year. Consequently the trade deficit fell. In order to augment its reserves, the SBP purchased US$ 2157 million from kerb market. Instead of direct intervention and moving the Rupee/Dollar band, monetary policy was the main tool to quell episodes of speculation in foreign exchange market and to smooth out the volatility caused by lumpy payments.

Post September 11, 2001; Pakistan experienced large inflows of foreign exchange and a consequent build up of foreign reserves and appreciation of the real effective exchange rate. It would seem that external factors played a crucial role in bringing home these foreign exchange inflows. Most noteworthy was the big upsurge in workers' remittances through official channels that resulted from the global crack down on illegal channels of money transfer. This led to the collapse of the *Hundi* system and disapperance of kerb market premium over official rate. Another contributing factor was the reversal of capital flight as the balances of Pakistani nationals came under scrutiny abroad. In addition, debt rescheduling and new large aid inflows to Pakistan for siding with the US and its allies in the war against terror augmented the net inflows

The tremendous improvement in Pakistan's external sector post September 2001, either directly or indirectly, contributed to positive developments for many macroeconomic indicators. For instance, workers' remittances almost doubled during FY02 in comparison with previous year to reach at US$ 2.39 billion. Together with increased official transfers, these inflows allowed SBP to augment its foreign exchange reserves and therefore perhaps a need to sterilize its impact on base money. Moreover, the current account recorded a surplus and underpinned the 6.2 percent appreciation of Pakistan Rupee. Indeed the purchases allowed the SBP to stabilize the exchange rate. The rationale for SBP intervention in foreign exchange market for slowing down of rupee

appreciation was the fear that this upsurge in inflows might be temporary. In short, while FY01 SBP foreign exchange interventions were to support Rupee, the FY02 buying was essentially to prevent it from strengthening too sharply.[6]

Furthermore the rupee liquidity injected through the foreign exchange purchases enabled SBP to ease its monetary policy which was contrary to FY01 when monetary policy was kept tight to support Rupee. Interestingly however, SBP reserve money growth was contained to only 9.6 percent, as injections through SBP foreign exchange purchases were sterilized by a net retirement of SBP's government securities holdings. The process of SBP-NDA reduction was particularly very intriguing, as the increased market liquidity (against SBP intervention) was neutralized without actually pursuing any explicit instrument for sterilization. Specifically, while most of the increased market liquidity was being channeled to the government securities, the government was retiring SBP-debt using borrowings from commercial banks. This resulted into a reduction of SBP-NDA. Hence, what seems to be a shift in domestic debt structure of the government actually helped the SBP's efforts to restrict monetary base expansion.[7]

In a sense, the sterilization pursued by SBP is not very different from open market operations: while this process shifts the SBP holdings of government securities to commercial banks *indirectly*, the open market operation achieves similar results *directly*. Looking at sterilization during FY02, the retirement of Rs 287 billion worth of government securities with SBP more than offset the impact of SBP intervention in the foreign exchange market. Consequently, as

[6] In FY01, the SBP injected doller liquidity into the interbank market to lower volatility and meet lumpy payments. The SBP was net seller in interbank market during FY01.

[7] The practice of sterilization had cost for SBP in terms of foregone interest earning on government securities etc. In addition, this could have increased quasi fiscal cost for government. However, low private sector credit demand left ample liquidity with the banks resulting in switch of government debt from SBP to banks without putting much pressure on interest. However we ignore this discussion here because it is not in the scope of this paper.

mentioned above, the reserve money growth was held down to 9.6 percent despite sizeable foreign exchange purchases by SBP.[8]

The FY03 also witnessed current account surplus owing to reduction in trade deficit and phenomenal increase in worker remittances to the tune of US$ 4237 million. SBP intervened heavily to stabilize the Rupee/Dollar parity by not letting it to appreciate too quickly. Indeed we can characterize this policy to be a pseudo free float, as SBP never allowed the Rupee to move freely. The SBP conceded that exchange rate practically acted as a nominal anchor for the monetary policy, which was discount rate during previous year. In contrast to FY02 position, when SBP essentially mopped up rupee liquidity resulting from its forex market interventions, FY03 saw a very deliberate reduction in these sterilization operations, despite a sharper rise in forex purchases (See SBP Annual Report FY03). This resulting liquidity flooding the banking system raised competitive pressures and led directly to fall in interest rates. As a result of low sterilization effort, reserve money grew by 14.5 percent without resulting in inflationary pressures, which can be attributed to lags in inflation dynamics.

During FY04, although net forex inflows declined relatively, the SBP continued with its loose monetary stance. In fact, net credit to private sector grew by Rupee 325 billion, which was more than twice the cumulative net credit expansion in preceding three years. The negative of this expansionary policy was the rise of inflationary expectation. Headline inflation measured by CPI was at 4.6 percent. This coupled with the reduction in unilateral inflows of foreign exchange put pressure on Rupee to depreciate.[9] All of these resulted in the upward pressure on interest rates. With relatively low inflows and deliberate expansionary monetary policy,

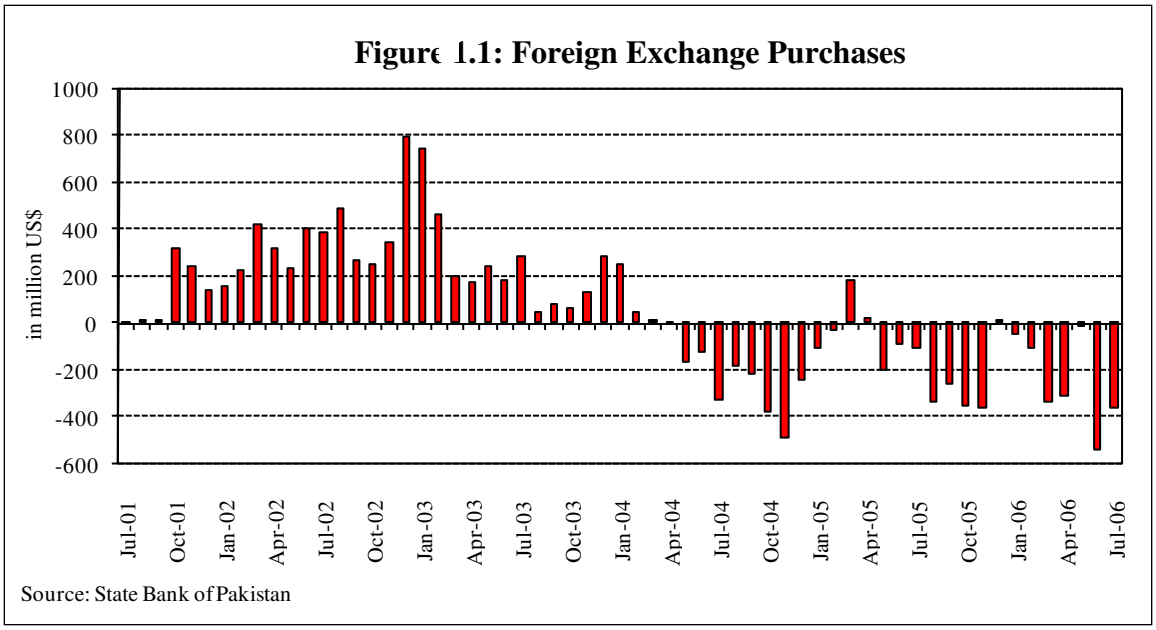
[8] SBP *Annual Report* for FY02.

[9] Saudi oil facility ended this year.

sterilization effort was on the lower side. As the Governor of the SBP stated "Despite some mopping up, the Central Bank has left excess liquidity with the banks which has driven down the cost of credit to historically low levels of 5 percent average. The banks are, therefore, reaching out to new customers particularly the middle and lower income groups by providing them agriculture credit, SME loans, mortgage loans and consumer loans. This is the most direct way the reserve accumulation is benefiting the common man…."[10]

However, with inflation peaking at 9.3 percent, SBP had to switch to tightening of monetary stance during FY05. This shift in policy was more pronounced during second half of the FY05, with the benchmark 6-month T-bill yield rising by 416 basis points during this period, as against 166 basis points increase in first half of the same year. However, despite this rise in interest rates monetary growth remained high at 19.3 percent. Current account deficit was recorded at US$ 1.4 billion, which stemmed mainly from trade deficit of US$6.2 billion during the year. However, worker remittances of US$4.0 billion helped finance this deficit. On net basis, SBP was a seller of foreign exchange in market (**Figure 1.1**). This aggressive selling was to defend the rupee from falling. Throughout the year and afterwards, SBP remained an active player in the foreign exchange market.

[10] A paper presented at Pakistan Administrative Staff College on March 11, 2004 by Dr. Ishrat Hussain, Governor, State Bank of Pakistan.



1.3: Literature Review

Central bank intervention following foreign exchange inflows has direct implications for the stance of monetary policy and the exchange rate. The coordination between two policies is achieved through sterilization. But the close coordination with monetary policy that sterilized intervention assumes may not be easy to achieve in practice.

In particular, intervention to resist appreciation might confuse the market when the central bank is raising interest rates to fight inflationary pressure. Truman (2003) raises the concern about distraction risk which means that the authorities might be tempted to postpone fundamental adjustments hoping that intervention will succeed. He shows that during the late 1970s intervention against a weak dollar was primarily used as a substitute for monetary tightening in the United States. But the delay in tightening monetary policy eventually led to a sharp rise in inflation and the need to raise interest rates to a very high level. The tighter monetary policy, in turn, led to one of the worst recessions in US postwar history.

Many economists have argued that intervention should be restricted to cases where it is consistent with the central bank's inflation forecast. This means that foreign exchange intervention should only be done when it is consistent with monetary policy goals. For instance, intervention to resist depreciation should be done where there is a forecast that inflation would rise above the target during the targeting horizon in case the depreciation materialized. Similarly, the central bank should intervene to resist appreciation only when inflation is expected to fall below the target. Holub (2004) argues that in the Czech Republic such coordination has been maintained since the introduction of inflation targeting in 1998. The most of the interventions against currency appreciation were carried out when (a) inflation was expected to fall below the target and (b) the output gap was negative.

Another strand of literature is concerned with the monetary authorities' ability to conduct sterilized intervention on a sustained basis. The first issue is that of the impossible trinity which asserts that with no capital controls, the central bank cannot indefinitely control both the nominal exchange rate and the money market rate [Mundell (1968)]. If intervention is to prevent depreciation, such a limit will be often set by the reserves and contingency credit lines available to a country. Depleting reserves will make an interest rate increase inevitable. On the other hand, a domestic credit expansion aimed at affecting internal markets cause a weakening of exchange rate through inflationary expectations. To maintain the official parity, the central bank must intervene in the foreign exchange market by buying high powered money with foreign reserves thereby offsetting the expansionary impact of domestic credit. If the offset to domestic credit expansion is complete, the monetary base is determined independently of the central bank's policies by the saving and portfolio decisions of the public. When the exchange rate is flexible, the level of exchange rate is determined by the supply and demand of currency. In this system,

the nominal money supply becomes a policy determined variable. However, the central bank can affect the monetary base in both cases, only when domestic and foreign assets are imperfect substitutes.[11] If there is perfect substitutability, the net foreign assets offset to domestic credit measures is immediate and complete, provided there are no lags in portfolio adjustments [Obstfeld (1982a)].

Second, the imperfect substitutability among assets means that changes in the supplies of such assets as a result of sterilization affect relative prices. For instance, Argy and Murray (1985) indicated that the central bank sells domestic bonds to sterilize its foreign exchange intervention. If domestic assets whose yield carries a risk premium; are imperfect substitutes of foreign assets, the authorities would have to pay higher interest rates on their sterilization bonds to encourage people to switch out of foreign assets.

Calvo et al (1993) argued on the un-sustainability of the sterilization effort. For instance resisting currency appreciation would prevent the domestic money market interest rate from falling, thereby would attract more inflows and thus continuously increase the need for sterilization. Eventually, the cost of sterilization would rise to high levels, forcing central bank to abandon sterilization effort; thereby leading to exchange rate appreciation. Therefore according to them, sterilization is difficult and costly. In the long run, appreciation of domestic currency value becomes unavoidable. It is also because with no sterilization, falling in interest rates and the resulting increase in inflation will lead to an appreciation of the real exchange rate.

This argument is empirically validated by several studies. Reinhart and Reinhart (1999) document evidences during the early 1990s and argued that large scale sterilized intervention had caused sharp increases in short-term interest rates in countries with high inflation history. In

[11] Assets can be imperfect substitute due to the presence of risk premium.

Chile, the short-term interest rate (30 to 89 day bank lending rate) rose from about 28% in the period (1988-89) preceding capital inflows to over 46% during the period (January to July 1990) of heavy inflows and sterilization. The rise in interest rates was as dramatic in Colombia, with prime lending rates of banks more than doubling from 22% during the pre-inflow period (1989-90) to over 47% during the peak of sterilization (January to November 1991). They concluded that "sterilization policies were either abandoned or scaled back or complemented by capital controls, as it became evident that the high domestic interest rates were attracting more inflows".

Finally, the high costs of issuing high yield local currency debt to acquire low yielding reserves can exacerbate fiscal deficits and so threaten macroeconomic stability. This issue is particularly serious if the country is already under large public sector debts. If trend continues, the combination of high costs and increasing reserves may provide a signal to markets that policy is unsustainable. Calvo (1991) argued that such effects would eventually weaken central banks' credibility by raising the probability of debt monetization and consequent high inflation. Comparing the high interest rate differentials of Chile and Colombia with Argentina, which followed a policy of nonsterilized intervention during the early 1990s, Calvo et al (1993) questioned the desirability of sterilized intervention because it raised debt service costs at a time when countries were attempting to bring domestic debt expansion under control.

Reisen (1993), however, argued that sterilization is easier than suggested otherwise. He asserts that some Asian countries have been able to achieve the impossible trinity of open financial markets, fixed exchange rates and the monetary independence through capital controls. Frankel (1994) examines the issue of foreign exchange inflows and the ability of the monetary authorities to conduct sterilized intervention. He concludes that sterilization is expensive when the cause of the capital inflows is a rise in money demand or an increase in exports. Attempts to sterilize such

inflows would raise interest rates, leading to even larger inflows, thereby rendering the sterilization practice as difficult and expensive. On the other hand, when the source of foreign exchange inflows is an external shock, sterilized intervention is not likely to alter the interest rates and hence it can be a viable option in the short run.

In short, possible consequences of prolonged sterilization could be that it could undermine monetary objectives; it could compromise financial stability; and it could impose heavy financing costs on the monetary authorities. Despite the possibility of these consequences and the concerns about coordination between intervention and monetary policy, monetary authorities do engage in sterilized intervention in the foreign exchange market. Since, failure to sterilize market intervention and the consequent increase in domestic liquidity can result in inflation as well as unwanted movement in exchange rate. In addition, the real exchange rate is also influenced by the ability of central banks to sterilize. Under these circumstances, determining the sterilization coefficients could be useful in terms of measuring of the scope and the stance of the monetary policy. Indeed, this issue has been discussed and empirically tested in the literature by several authors.

Argy and Kouri (1972) estimated the sterilization coefficient by two-stage least squares using instrumental variables. They found evidence of partial sterilization on part of Germany and the Netherlands, but inconclusive evidence for Italy. Kouri and Porter (1974) developed a model of international capital flows and applied it to the data of Germany, The Netherlands, Australia and Italy. The offset coefficient which measures the extent, to which capital flows offset policy induced changes in monetary base, were statistically significant in all cases. The estimates were -0.77 for Germany, -0.59 for Netherlands, -0.47 for Australia, and -0.43 for Italy. All these

estimates are statistically different from minus one, which suggested that sterilization was possible in these countries at least in short run.

Miller and Askin (1976) examines the degree to which the balance of payment of two small, relatively open economies influence the ability of their monetary authorities to control the money supply. More specifically, they investigate to what extent variations in the domestic components of monetary base are offset via international payment imbalances, and then to what extent the authorities sterilize the effect of payments imbalances on monetary base. They built a simple model that incorporates the monetary approach to the balance of payments for Brazil and Chile. They used the reduced-form solutions and two stage-least square regressions to tackle the issues of simultaneity between (a) changes in the international and domestic components of the monetary base and (b) the level of income and the monetary base. The empirical results concluded that only a relatively small portion of changes in domestic component of monetary base was offset through the balance of payments while authorities completely sterilized the impact of payments imbalance on monetary base. Their results suggest that the monetary authority in these countries had almost complete control over money supply. However, Sheehey (1980) used an alternative specification of Miller and Askin (1976) model and suggested a limited ability of monetary authorities to influence the money supply.

Kamas (1986) used a reduced form equation derived from a general macroeconomic model. Kamas made estimations in the context of three different specifications: the monetarist, the portfolio balance, and Keynesian for the period of 1971:03 to 1981:4 for Mexico and for the period of 1970:4 to 1982:04 for Venezuela. The sterilization coefficient came out to be -1.55 and -1.04 respectively for Mexico and Venezuela.

Altınkemer (1997) estimates the domestic credit reaction function of Central Bank of Turkey (CBRT) by dividing the estimation period into two sub-periods, February 1990-October 1993 and April 1994-June 1997. Study concludes that, during the pre-financial crisis period, it seems that the CBRT was reacting to changes in net foreign assets (NFA), real exchange rate and not to interest differential. While in the post financial crisis period, it seems that the CBRT reacted more to NFA changes compared to the pre-crisis period and also interest rate differentials gained importance in the monetary policy framework. The sterilization coefficients have been found as 0.82 and 0.91 for the first and second periods respectively by using OLS.

Another study for Turkey on the same subject by Celasun et al, (1999) computed the sterilization coefficients. They used two-stage least squares, for the period February 1990 to June 1996, wherein the reaction function allows net domestic assets to respond to other variables, such as, net foreign assets, real exchange rate, real GDP and consolidated government deficit. For the whole period, the sterilization coefficient was found as -0.37, which indicated partial sterilization of 37 percent of reserve inflows.

Emir et al (2000) estimated monetary policy reaction function for Turkey and calculated the offset and sterilization coefficient using simultaneous equation system for the periods of 1990 to 1993 and 1995 to 1999. The results showed that in the first period which is the pre-crisis period (1990-1993), low degree of sterilization, offset and neutralization coefficients, which suggest that the CBRT implemented a relatively accommodative policy to fiscal policy by expanding domestic credits to finance budget deficit. In contrast, in the second period which is the post-crisis period (1995-1999), the CBRT implemented more active policy by sterilizing most of the foreign assets increase and neutralizing the government credits by reducing the banking sector credits which was reflected in the high level of sterilization, offset and neutralization coefficient.

Siklos (2000) focused on short run impact of sterilization on monetary policy and found that Central Bank of Hungary (NBH) fully sterilized capital inflows during 1992:01 to 1997:03 and the sterilization coefficient thus found was 1.002 by using OLS method.

Patnaik (2004) used error correction procedure to analyze the sterilization practice of Reserve bank of India (RBI) using monthly data for period April 1993 to December 2003. The result suggests that RBI directly sterilized its currency intervention by a reduction in net domestic assets. However, though the extent of sterilization was large, it was not complete and the coefficient was estimated to be -0.8.

Korea witnessed surge in capital inflows and improvement in current account in early 90s. During this period, Bank of Korea actively intervened into the foreign exchange market and balances the monetary impact of foreign exchange interventions through sterilization. Kim (1991) estimated 90 percent sterilization of increase in net foreign assets during the 1980s.

Cavoli and Rajan (2005) estimated sterilization coefficients for Korea, Thailand, Indonesia, Malaysia and Philippines for the monthly observation for the period January 1990 to March 1997. The estimates for Korea (-1.11) suggest possible over-sterilization as the coefficient exceeds -1 and those for Indonesia are lower than the others at -0.76. The estimates for Thailand (-0.91), Malaysia (-0.94) and Philippines (-0.97) suggests almost complete sterilization of inflows.

In other studies on the issues, Renhack and Mondino (1988) and Clavijo (1986) for Colombia; Blejer and Leiderman (1981) for Brazil; Fry et al (1991) for Pacific Basin Countries; Savvides (1998) for West and Central African countries, the sterilization coefficients were estimated to measure the coordination of monetary and exchange rate policy

Qayyum and Khan (2003) used the domestic policy reaction function to gauge the degree of sterilization by investigating the long run relationship using cointegration technique for Pakistan. They used quarterly data from 1982Q3 to 2001Q2 and concluded that State Bank of Pakistan (SBP) did sterilize 72 percent of capital inflows for the period.

1.4: Theoretical Framework

To capture the SBP's reaction to policy choices in the face of foreign exchange inflows, we form a simple Aggregate Demand -Aggregate Supply model. Aggregate supply is represented by expectations augmented Phillips curve, where agents have adaptive learning and nominal rigidity makes policy effective. Modeling strategy was essentially Neo-Keynesian Transmission Mechanism with back ward looking pricing as described by Cukierman (2002). Model was modified to explicitly take into account IS-LM frame work with an equation describing the exchange rate. Svensson (1996) notes that despite simplicity, this type of model captures some of the essential features of the more elaborate econometric models used by central banks. As Cukierman (2002) states that this model reflects the declared belief of central banks that current policy interest rates affects the output gap with a lag of one period and rate o inflation with a lag of two periods.

Consider the following expectations augmented Phillips curve equation

$$\pi_t - \pi_t^e = -\alpha(u_{t-1} - u^*) + e_t$$

$$\pi_t = \pi_t^e - \alpha(u_{t-1} - u^*) + e_t$$

Where u^* is natural rate of unemployment and u is the unemployment rate in the economy. $\pi_t = p_t - p_{t-1}$is inflation in period t. $p_t$is log of consumer price index at period t. coefficient α is assumed to be negative implicating that a positive unemployment gap in current period would

result in decreased inflation rate in the next period. Finally e is independently and identically distributed supply shocks.

In above equation, Inflation in period t is considered to be a function of inflationary expectations for period t and the deviation of lagged unemployment rate from the natural rate.

In adaptive expectations, expected inflation rate is weighted average of past inflation rates with maximum weight attached to the near past.

$$\pi_t^e = ב\pi_{t-1} + ב(1-ב)\pi_{t-2} + ב(1-ב)^2\pi_{t-3} + \cdots$$

Where ב is parameter representing speed of adjustment.

Assuming, for simplicity, $ב = 1$, we get

$$\pi_t^e = \pi_{t-1}$$

Substituting this in Phillips curve equation, we get

$$\pi_t = \pi_{t-1} - \alpha(u_{t-1} - u^*) + e_t$$

The second term on right hand side of above equation can be replaced by deviation of employed labor force from natural rate.

$$\pi_t = \pi_{t-1} + \beta\left(\frac{N_{t-1} - N^*}{N^*}\right) + e_t$$

In our model output is produced using only labor. This is consistent with McCallum and Nelson (1999) who showed that there is very little connection between changes in capital stock and those of aggregate output over the business cycle. A typical year's investment is small compared to existing stock of capital, and due to small correlation between capital and output, above

assumption is appropriate. Output is produced using labor according to following Cobb-Douglas production function

$$Y_t = \gamma N_t$$

Substituting the value of N from production function into Phillips curve equation, we get

$$\pi_t = \pi_{t-1} + \beta \left(\frac{Y_{t-1}/\gamma - (Y/\gamma)^*}{(Y/\gamma)^*} \right) + e_t$$

$$\pi_t = \pi_{t-1} + \beta \left(\frac{Y_{t-1} - Y^*}{Y^*} \right) + e_t$$

$$\pi_t = \pi_{t-1} + \beta y_{t-1} + e_t$$

Where y_{t-1} is percentage deviation of lagged output from the potential level is output gap.

Above equation can be written one period forward as

$$\pi_{t+1} = \pi_t + \beta y_t + e_{t+1} \qquad (1)$$

Where coefficient β is assumed to be positive implicating that a positive output gap in period t would result increase in inflation rate in next period.

Following Dornbusch (1976) we use standard open economy IS-LM frame work to represent demand side of the economy. All variables except interest rates are in log form.

$$y_t = a + b(e_t + p_t^* - p_t) - cr_t \qquad (i)$$

Equation (i) defines a standard IS relation: aggregate demand depends positively on terms of trade and negatively on the interest rate. Equation (i) can be written as

$$y_t = a + b(e_t + p_t^* - p_t) - c(i_t - p_t)$$

$$y_t = a + b(e_t + p_t^* - p_t) - ci_t + cp_t \quad \text{(ii)}$$

$$m_t - p_t = ky_t - gi_t \quad \text{(iii)}$$

Equation (iii) is a standard LM equation.

$$i_t = i_t^* - \Delta e_{t+1} \quad \text{(iv)}$$

Equation (iv) is interest parity condition which states that arbitrage by risk neutral agents keeps the domestic interest rates equal to foreign interest rate plus any expected gain that can be had by holding assets in foreign currency.

From (iii)

$$i_t = \left(\frac{k}{g}\right) y_t - \left(\frac{1}{g}\right)(m_t - p_t)$$

Substituting in (ii)

$$y_t = a + b(e_t + p_t^* - p_t) - c\left[\left(\frac{k}{g}\right) y_t - \left(\frac{1}{g}\right)(m_t - p_t)\right] + cp_t$$

$$y_t = a + b(e_t + p_t^* - p_t) - (ck/g)y_t + \left(\frac{c}{g}\right)(m_t - p_t) + cp_t$$

$$y_t = \left({}^{ag}/_{g+ck}\right) + \left({}^{bg}/_{g+ck}\right)(e_t + p_t^* - p_t) + \left({}^{c}/_{g+ck}\right)(m_t - p_t) + cp_t$$

$$\Delta y_t = \emptyset(\Delta e_t + \Delta p_t^* - \Delta p_t) + \theta(\Delta m_t - \Delta p_t) + c\Delta p_t$$

Where $\emptyset = ({}^{bg}/_{g+ck})$ and $\theta = ({}^{c}/_{g+ck})$

$$\Delta y_t = \emptyset(\Delta e_t + \Delta p_t^*) - (\emptyset + \theta - c)\Delta p_t + \theta \Delta m_t$$

$$y_{t+1} = y_t + \theta \Delta m_t - (\emptyset + \theta - c)\pi_t + \emptyset(\Delta e_t + \Delta p_t^*) + v_{t+1} \quad (2)$$

Following Svensson (1996) long run natural output level is normalized to 1. So y_t in above equation denotes log of output relative to log of potential output (output gap). θ is assumed to be positive indicating that an increase in real money supply in period t will result in positive output gap in period t+1. This also means that changes in money supply would impact inflation with a lag of two periods.

Equation (1) can be written as

$$\pi_{t+2} = \pi_{t+1} + \beta y_{t+1} + e_{t+2}$$

Substituting y from equation (2)

$$\pi_{t+2} = \pi_{t+1} + \beta[y_t + \theta\Delta m_t - (\emptyset + \theta - c)\pi_t + \emptyset(\Delta e_t + \Delta p_t^*) + v_{t+1}] + e_{t+2}$$

$$\pi_{t+2} = \pi_{t+1} + \beta y_t + \beta\theta\Delta m_t - \beta(\emptyset + \theta - c)\pi_t + \beta\emptyset(\Delta e_t + \Delta p_t^*) + \beta v_{t+1} + e_{t+2}$$

Substituting (1)…

$$\pi_{t+2} = \pi_t + \beta y_t + e_{t+1} + \beta y_t + \beta\theta\Delta m_t - \beta(\emptyset + \theta - c)\pi_t + \beta\emptyset(\Delta e_t + \Delta p_t^*) + \beta v_{t+1} + e_{t+2}$$

$$\pi_{t+2} = [1 - \beta(\theta + \emptyset - c)]\pi_t + 2\beta y_t + \beta\theta\Delta m_t + \beta\emptyset(\Delta e_t + \Delta p_t^*) + e_{t+1} + e_{t+2} + \beta v_{t+1}$$

$$\pi_{t+2} = a_1\pi_t + a_2 y_t + a_3\Delta m_t + a_4(\Delta e_t + \Delta p_t^*) + e_{t+1} + e_{t+2} + \beta v_{t+1}$$

Where $1 - \beta(\theta + \emptyset - c) = a_1$

$2\beta = a_2$

$\beta\theta = a_3$, and

$\beta\emptyset = a_4$

Taking expectation, we get

$$E_t\pi_{t+2} = a_1\pi_t + a_2 y_t + a_3\Delta m_t + a_4(\Delta e_t + \Delta p_t^*) \quad (3)$$

Now we assume that central bank conducts its monetary policy such that the rate of inflation does not go beyond a certain threshold level (say π^*). That means, the central bank will choose the value of its instrument (m_t in our case) in next two periods to minimize

$$\min_{\Delta m_t} E_t\delta^2 L(\pi_{t+2})$$

E_t represents the conditional expectations based on the information available in period t. δ is discount factor and its value is assumed to lie between 0 and 1.

$L(\pi_{t+2}) = \frac{1}{2}(\pi_{t+2} - \pi^*)^2$ is the period loss function.

The first order condition is

$$\frac{\partial E_t\delta^2 L(\pi_{t+2})}{\partial \Delta m_t} = E_t\left[\delta^2(\pi_{t+2} - \pi^*)\frac{\partial \pi_{t+2}}{\partial \Delta m_t}\right] = 0$$

$$\frac{\partial E_t\delta^2 L(\pi_{t+2})}{\partial \Delta m_t} = E_t[\delta^2(\pi_{t+2} - \pi^*)a_3] = 0$$

$$\frac{\partial E_t\delta^2 L(\pi_{t+2})}{\partial \Delta m_t} = a_3\delta^2[E_t\pi_{t+2} - \pi^*] = 0$$

$$\Rightarrow E_t\pi_{t+2} - \pi^* = 0$$

$$\Rightarrow E_t\pi_{t+2} = \pi^* \quad (4)$$

Substituting (3) in (4)

$$\pi^* = a_1\pi_t + a_2 y_t + a_3\Delta m_t + a_4(\Delta e_t + \Delta p_t^*)$$

$$a_3\Delta m_t = \pi^* - a_1\pi_t - a_2 y_t - a_4(\Delta e_t + \Delta p_t^*)$$

Adding and subtracting $a_1\pi_t$ on RHS.

$$\Delta m_t = \pi_t + \frac{1}{a_3}(\pi^* - (a_1 + a_3)\pi_t) - \frac{a_2}{a_3}y_t - \frac{a_4}{a_3}(\Delta e_t + \Delta p_t^*)$$

Substituting the values of $a_1, a_2, a_3 and\ a_4$

$$\Delta m_t = \pi_t + \frac{1}{\beta\theta}[\pi^* - (1 - \beta(\theta + \emptyset - c) + \beta\theta)\pi_t] - \frac{2}{\theta}y_t - \frac{\emptyset}{\theta}(\Delta e_t + \Delta p_t^*)$$

$$\Delta m_t = \pi_t + \frac{1}{\beta\theta}[\pi^* - (1 - \beta\theta - \beta\emptyset + \beta c + \beta\theta)\pi_t] - \frac{2}{\theta}y_t - \frac{\emptyset}{\theta}(\Delta e_t + \Delta p_t^*)$$

$$\Delta m_t = \left(\frac{\theta + \emptyset - c}{\theta}\right)\pi_t - \frac{1}{\beta\theta}[\pi_t - \pi^*] - \frac{2}{\theta}y_t - \frac{\emptyset}{\theta}(\Delta e_t + \Delta p_t^*)$$

$$\Delta m_t = b_0\pi_t + b_1[\pi_t - \pi^*] + b_2 y_t + b_3(\Delta e_t + \Delta p_t^*) \quad (5)$$

Where

$$\left(\frac{\theta + \emptyset - c}{\theta}\right) = b_0$$

$$-\frac{1}{\beta\theta} = b_1$$

$$-\frac{2}{\theta} = b_2$$

$$-\frac{\emptyset}{\theta} = b_3$$

From interest parity condition (iv)

$$i_{t-1} - i_{t-1}^* = \Delta e_t$$

Substituting in (5)

$$\Delta m_t = b_0\pi_t + b_1[\pi_t - \pi^*] + b_2 y_t + b_3(i_{t-1} - i_{t-1}^*) + b_3\Delta p_t^*)$$

$$\Delta m_t = (b_0 + b_1)\pi_t + b_2 y_t + b_3(i_{t-1}) + b_3(\Delta p_t^* - i_{t-1}^*) - b_1\pi^* \quad (6)$$

We also know that the identity

$m_t = NFA_t + NDA_t$

The NFA is the net foreign assets, while the NDA is the net domestic assets of the central bank.

$\Delta m_t = \Delta NFA_t + \Delta NDA_t$

Substituting this relation in to (6), we get

$$\Delta NDA_t = (b_0 + b_1)\pi_t + b_2 y_t + b_3(i_{t-1}) + b_3(\Delta p_t^* - i_{t-1}^*) - b_1\pi^* - \Delta NFA_t \quad (7)$$

$$\Delta NDA_t = \alpha_1\pi_t + b_2 y_t + b_3(i_{t-1}) + b_3(\Delta p_t^* - i_{t-1}^*) - b_1\pi^* - \Delta NFA_t \quad (8)$$

Where given the fact that π^* is some target which does not change, the Δp_t^* and i_{t-1}^* are foreign inflation and interest rates which can be taken as exogenous. Therefore we assume $b_3(\Delta p_t^* - it{-}1{*}{-}b1\pi{*}{=}\alpha 0$ as an intercept.

$$\Delta NDA_t = \alpha_0 + \alpha_1\pi_t + b_2 y_t + b_3(i_{t-1}) - \Delta NFA_t \quad (9)$$

The estimatable form of equation (9) can be as

$$\Delta NDA_t = A + b_1\pi_t + b_2 y_t + b_3 i_{t-1} - \Delta NFA_t + error \quad (10)$$

The coefficient of $\Delta NFA_t\ is\ of$ our prime interest which will be (-1) if there is perfect sterilization of central bank interventions in the foreign exchange market. It would mean that domestic money supply is kept independent of foreign inflows as a conscious policy. Under such circumstances, domestic money is independent of balance of payment swings and is entirely determined by other factors. This also means that central bank can potentially strive to achieve internal and external equilibrium simultaneously; provided that the sterilized intervention impacts the exchange rate as discussed by Obstfeld (1982b). If so, the central bank would have two instruments to achieve two competing goals, at least in the short run. It is important to

recognize that the finding that the monetary authority completely sterilized its foreign exchange intervention does not provide evidence that these interventions have an impact on exchange rate. According to portfolio balance theory, the efficacy of foreign exchange intervention happens if the domestic and foreign bonds/assets are imperfect substitutes. In that case, sterilized foreign exchange intervention when used in combination with domestic credit expansion, enables monetary authority to lower the nominal interest rates in the short run, while holding the exchange rate constant [Obstfeld (1982b)]. It is worth noting that information about the efficacy of interventions cannot be obtained from the reaction function of the SBP as it only describes the behavior of the authorities. Question of efficiency only arise, if the sterilization is complete. As Sarno and Taylor (2001) mentioned that there is consensus in the literature that unsterilized intervention would impact the exchange rate similar to monetary policy by inducing changes in the stock of the monetary base which, in turn, induces changes in broader monetary aggregates, interest rates, market expectations and eventually the exchange rate. However, the efficacy of sterilized intervention is controversial, therefore the debate on the effectiveness of official intervention in the foreign exchange market mostly relates to sterilized intervention. If sterilization is complete then we should investigate the efficacy of the intervention in next step to know whether the SBP used the sterilized intervention to achieve the internal and external objectives simultaneously.

1.5: Econometric methodology and data issues

The data on net foreign assets (NFA) in domestic currency is adjusted for valuation changes due to periodic exchange rate changes which are not reflected as a change in monetary base. Similarly we considered the possibility of changes in reserve requirement of the central bank on domestic credit expansion. Estimation is done through GMM technique for the monthly data for

the period 2001:1 to 2007:06. The choice of period is important as it covers the period of significant foreign exchange inflows and covers the boom period prior to the 2008 balance of payment crises. This technique was chosen so as to take in to account the endogeneity problem between the changes in domestic credit and the various arguments of the reaction function such as changes in foreign reserves, inflation and interest rate. This is important as Kouri and Porter (1974) and Obstfeld (1982a) and many other have pointed out that the coefficient is subject to a possible sterilization bias. The source of the bias is the possible endogeneity of changes in domestic credit when central bank follows a sterilization policy. If capital inflow is systematically sterilized, the change in NDA will be correlated with the disturbance term in the NFA equation, therefore OLS estimates will be inconsistent. [12]

Foreign reserves of the SBP are used as proxy for Net Foreign Assets (NFA) of the SBP. NFA include liquid reserves and gold holdings of the central bank. Since gold holdings do not change periodically, all the variations in NFA can be attributed to changes in foreign reserves held by SBP. Therefore changes in NFA can be proxied by the changes in liquid reserves (LR) of the central bank. Because exchange rate fluctuations entail changes in domestic currency valuation of reserves which are not reflected as a change in monetary base, the measure ΔLRa take cares the periodic reserve valuation adjustment due to change in exchange rate [Obstfeld(1982b)]. ΔLRa is the change in the foreign exchange reserves of the SBP in terms of domestic currency. ΔLRa is constructed as following.

$$LRa_t = [LR_{t-1} * ER_{t-1} + (LR_t - LR_{t-1})ER_t]$$

$$\Delta LRa_t = (LRa_t - LRa_{t-1})$$

[12] For detailed discussion on sterilization bias, see Obstfeld (1982)a.

Where LR are liquid reserves of SBP and LRa means liquid reserves adjusted for valuation due to exchange rate changes. ER_t is t-period average exchange rate of domestic currency for 1 unit of foreign currency. Normalizing with monetary base (MB), we get

$$R_t = (LRa_t - LRa_{t-1})/MB_t$$

NDA is constructed by deducting LRa_t from monetary base MB, according to the method of Leiderman (1984). So change in domestic credit is constructed as following.

$$DC_t = (NDA_t - NDA_{t-1})/MB$$

However, the change in net domestic assets does not provide a complete picture of the stance of the domestic credit policy of the central bank. The variation in reserve requirements on banks has important implications in domestic credit expansion. The change in domestic credit should therefore be defined as the increase in net domestic assets minus the reserve impounded by any increase in required reserves. Following [Obstfeld(1982b)], this later component can be calculated as following.

$$(RR_t - RR_{t-1}) * scheduled\ bank\ deposits_{t-1}$$

However, since there is no change in reserve requirement during the period understudy (2001:1 to 2006:8) except the 2nd last month i.e., July 2006, we decided not to adjust the data for this (see **Table 1.E** in Annexure for Changes in Cash Reserve Requirement by SBP).

Indicative domestic short term interest rates $cmr$are the call money rate. Inflation variable inf $\_m$ is calculated using monthly CPI on change from previous month basis.

$$inf\_m = [ln(CPI_t) - ln(CPI_{t-1})]$$

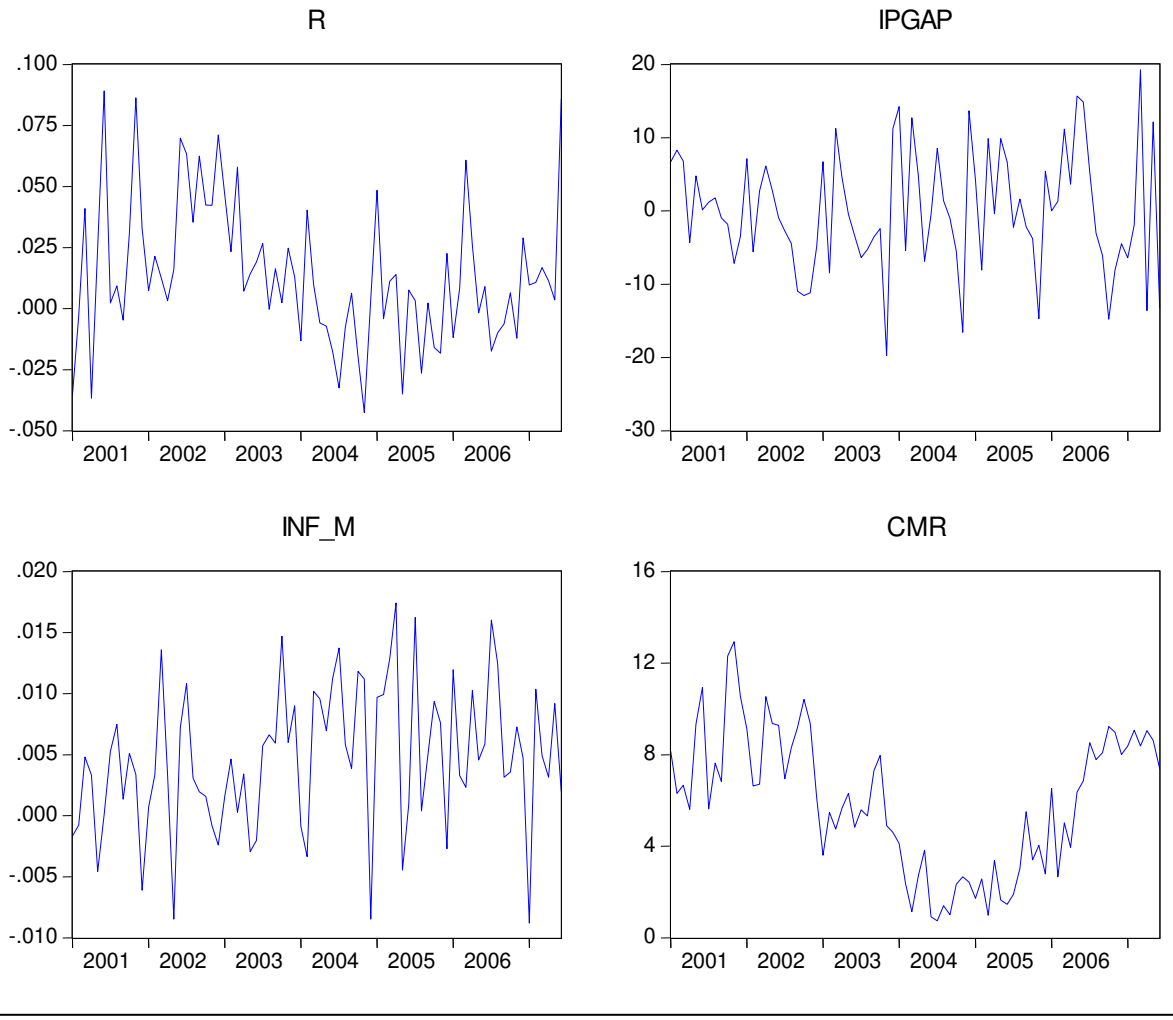
$$inf\_m = [cpi_t - cpt_{t-1}]$$

Data on Industrial Production Index (IPI) is taken from Federal Bureau of Statistics (FBS) publications to proxy the real sector activity. To calculate the output gap, we used the HP filter on IPI to get its permanent component.

$$IPGAP = [IPI_t - hpIPI_t]$$

Data on monetary base (MB) and call money rate $(cmr), IPI, CPI$ is taken from IMF's International Financial Statistics. Data on liquid reserves LR is taken from the SBP publications.

Figure 1.2: Plots of Data



The ADF unit root test in **Table 1.1** found that for all variables except $cmr(-1)$, we can reject the hypothesis of unit root.

Table 1.1: Unit Root Test Results

		ADF			Conclusion
1	DC (Domestic credit)	-8.8241*	[0]	none	No unit root
2	R (Foreign Reserves)	-1.8903***	[2]	none	No unit root
3	$IPGAP$(Industrial output gap)	-8.3126*	[0]	none	No unit root
5	inf_m (Monthly inflation)	-2.1585**	[2]	none	No unit root
6	$cmr(-1)$ (Call money rate)	-0.7427	[1]	none	unit root

*significant at 1 %; **: significant at 5%; *** significant at 10%

ADF Test critical values:	1% level	-2.596160
	5% level	-1.945199
	10% level	-1.613948

Lag selection Automatic through Schwarz Information Criterion

Information contained in monthly data may be limited, owing to strong seasonal variation. The presence of seasonal variation in the data can severely restrict firm conclusions about the interaction of variables. The degree of seasonality in the data was examined by carrying out a simple F-test by regressing each variable on monthly seasonal dummies. The null hypothesis implied no seasonality. (All coefficients of the seasonal dummies are simultaneously tested zero), while rejection of null implied the presence of seasonality in data. The test strongly supports the null hypothesis of no seasonality in the data. Therefore subsequent estimation will not contain seasonal dummies.

1.6: Empirical Evidence and policy implications

We have chosen GMM technique for estimation of the equation (10) owing to endogeneity problem between variables. The estimation yielded intuitively appealing results[13][14]. The J-statistic reported at the bottom of the Table 1.2 is the minimized value of the objective function.

[13] The variable on output gap in constructed using HP-Filter. However, applying HP filter could result in over smoothing of the true output gap. To check the robustness of result, we also estimated this regression using output gap derived through using simple linear trend. The results reported in Table 1.F of Annexure, show that they are robust and do not change with the output gap calculated through linear trend.

[14] We estimated the equation with intercept too. But it turned out to be statistically insignificant.

A simple application of the J-statistic is to test the validity of over identifying restrictions when we have more instruments than parameters to estimate.

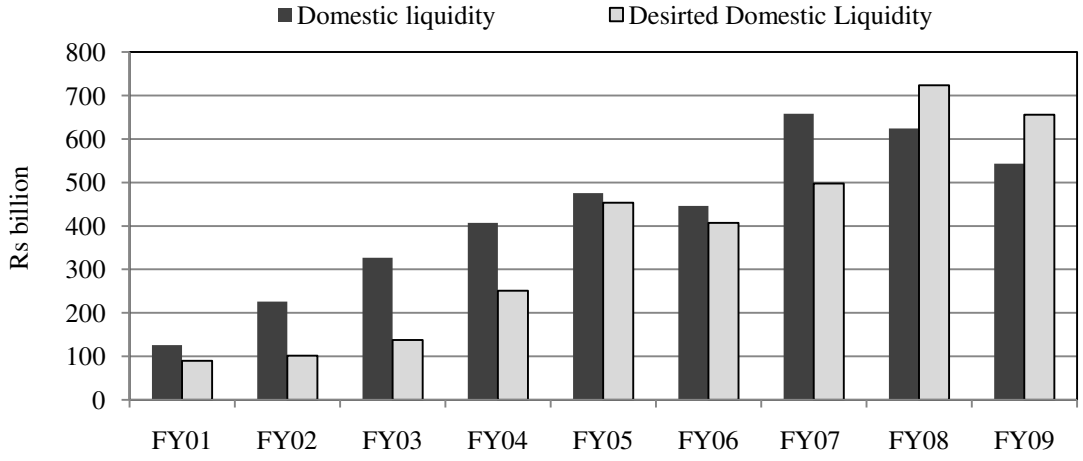
Table1.2: Estimation Results

	Coefficient	Std. Error	t-Statistic	Prob.
R	-0.699278	0.040160	-17.41230	0.0000
IPGAP	-0.001619	0.000283	-5.721525	0.0000
Inf_m	0.501180	0.109375	4.582220	0.0000
d(cmr(-1))	0.001634	0.000694	2.356078	0.0221
R-squared	0.457217	Mean dependent var		-0.003102
Adjusted R-squared	0.427063	S.D. dependent var		0.041285
S.E. of regression	0.031250	Sum squared resid		0.052734
Durbin-Watson stat	2.163511	J-statistic		0.226584

Under the null hypothesis that the over identifying restrictions are satisfied, the J-statistic times the number of regression observations is asymptotically chi-square with degrees of freedom equal to the number of over identifying restrictions. This value is 13.1419 with the probability equal to 0.997 means that the null hypothesis that identifying restrictions are satisfied is accepted in our case.

The result does not support the hypothesis that the SBP fully sterilized its foreign exchange interventions. The sterilization coefficient turns out to be -0.699 (statistically different from -1) meaning that the SBP adopted a policy of partial sterilization or was unable to sterilize its foreign exchange interventions fully. More specifically, the SBP did not use domestic credit policy to attain domestic policy objectives while engaging in sterilized intervention in foreign exchange market to influence exchange rate. It suggests that the SBP in the presence of managed floating exchange rate regime was only partially able to preserve its monetary independence. This is in conformity with result reported in [Aizenman and Glick (2008)] for many developing countries.

Figure 1.3: Monetary Overhang



Source: State Bank of Pakistan and own calculations

The vulnerable external account position; unsustainable debt, pressures on exchange rate, high fiscal deficit, low investment, weak infrastructure, excess capacity, absence of confidence on economy and a shallow financial sector were summed up in slow economic growth, high unemployment, low inflation at the start of this decade. This required some policy stimuli to restore confidence and economic activity. Adhering to its commitment to bring down fiscal deficit, the government had limited room to provide any fiscal stimulus to boost economic activity. Similarly monetary policy stimulus was inhibited by weak external account position and shallow financial markets since any effort to ease domestic interest rates would have exerted depreciation pressures on Pak rupee.

The situation, however, became more favorable with the post September 2001 changes in the economy. The massive foreign exchange inflows owing to substantial increase in workers' remittances turned the current account deficit into a surplus in FY01 after FY73, allowing the buildup of foreign exchange reserves and appreciation of rupee. Parallel to these developments, the policy changes to bring down debt servicing cost also began bearing fruits. Specifically, the external debt-to-GDP ratio trended downwards supporting both the current account and the fiscal

position. All these external factors led to an increased share of net foreign assets in the overall monetary expansion in FY01 and subsequent years. To ward off the excessive pressures on exchange rate in order to safeguard the competitiveness of exporters and reduce import costs, the SBP allowed only a gradual increase in the value of rupee. At the same time, given the low level of inflation, the SBP chose to stimulate economic activity by following an easy monetary policy stance. To achieve both ends, the SBP conducted measured interventions to pick foreign exchange from the market and partially sterilized (at least initially) its impact by withdrawing the resulting rupee liquidity.

Mohanty and Turner (2005) discussed that in some circumstances the central bank appeared to be focusing on resisting currency appreciation as well as easing its monetary stance. If so, intervention would create no conflict with monetary policy and hence there is no need to fully sterilize these. It is because a non-sterilized foreign exchange purchase by central bank would resist the appreciation of domestic currency and at the same time leave the ample domestic currency in market to support expansionary monetary policy. For this they cited the example of south East Asian countries. The SBP reports and statements by the Governor at that time clearly indicate the need to loosen up its monetary stance to provide stimulus to domestic economy.

However, after remaining subdued for some time period, inflation began to accelerate as the growth in aggregate demand outstripped productive capacity, underpinned by the excess liquidity in the system. The excessive monetary expansion during FY02 to FY05, due to partial sterilization, resulted in accumulation of monetary overhang to a large extent, complicating the efforts to bring down inflation in the later years (Figure 1.3). The excess domestic liquidity

worth almost Rs364 billion was left unsterilized in the system during FY01 to FY03.[15] Consequently, the domestic interest rates declined to a large extent and private sector credit picked up sharply in FY03 onwards and inflationary pressures began to shape up.

Evidence suggests that less than complete sterilization by SBP was a combination of its will to leave liquidity initially and later to its inability to sterilize fully when it was required. Despite the low sterilization effort, the SBP had retired most of its stock of market related treasury bills (MRTBs) during FY01 to FY03. As a result of this retirement, the stock of MRTBs with the SBP declined from Rs.196 billion at end-June 2000 to Rs.51.747 billion on August 2003 reducing the availability of MRTBs substantially for day-to-day liquidity management through open market operations. In addition, SBP was unable to device other means such as issuance of its own paper, to sterilize its interventions. Consequence of the resulting monetary overhang was evident in the rising inflationary trends since 2005.

The coefficient of inflation 0.50 is significant, and contrary to expectations, is positive. However, this result is in conformity with the result arrived by another study by Malik and Ahmed (2010). Economic theory and SBP's mandate of price stability suggest that the sign of coefficient should be negative. That means if inflation is moving upwards, the domestic credit by the central bank need to be tightened. However, this anomaly can be explained by looking at the macroeconomic environment at 2001. Economy was in recession and inflation was subdued. The availability of excess capacity in the economy initially helped economic recovery while keeping the inflation subdued for couple of years despite expansionary monetary policy. However, inflation gained strength especially after 2005 and still persists.

[15] The excess domestic liquidity of a year was calculated by taking difference between actual and the desired M2 flows. Desired M2 flow was the flow which would have been consistent with that particular year's inflation and real GDP growth.

One important policy implication is that the central bank needs to be forward looking to know the leads and lags of monetary policy in the economy. The central bank needs to enhance its ability to forecast inflation. Also important is to note that despite SBP's apparent tightening since 2005, it failed to control monetary growth within desired levels due to excessive government borrowings and also due to lump sum foreign inflows as a result of privatization, which were only partially sterilized. That explains the apparent positive relation between inflation and domestic credit during the period under study. In other word, out of two objectives of controlling prices and helping growth, the SBP mainly focused on growth and less on the price stability in its objective function.

The statistically significant coefficient (-0.002) of $IPGAP$ (representing the output gap) supports the hypothesis that during the period SBP mainly focused on the economic growth. Importantly, this coefficient has plausible negative sign. That mean SBP largely followed the counter cyclical monetary policy. We can infer that monetary policy is potent in stimulating the economic growth in Pakistan through its impact on aggregate demand. The infusion of liquidity helped SBP to keep the interest rates at very low levels. This not only helped reduce the government debt servicing cost to provide it fiscal space to spend on infrastructure project but also induce private sector to borrow. This increased aggregate demand helped economy recover from the recession. But more important is to realize that this increased demand brings with it the inflation which more than nullifies the benefit of any growth.

In short, the coefficients of inflation and output gap also imply that it is very difficult for the SBP to focus on both its statutory objectives of growth and price stability. It has to let go one to achieve other. This lesson is learned by lot of central banks worldwide who now primarily focus only on inflation. That does not mean that central bank in developing countries could completely

do away with the growth objective. It only says that inflation should have bigger weight in the loss function of the central bank. It is important to note that there is consensus that price stability is important for the long term economic growth. Price stability promotes long-term growth by providing an environment in which economic decisions can be made with less uncertainty and therefore markets can function without concern about unpredictable fluctuations in the purchasing power of money. High and unanticipated inflation lowers the quality of the signals coming from the price system, as producers and consumers find it difficult to distinguish price changes arising from changes in supply and demand considerations from changes arising from high level of general inflation.

In its present form, the SBP Act appears to be outdated and inconsistent with international best practices. Despite the fact that functions and role of SBP have substantially changed over time, required legislative changes in the Act have not been carried out accordingly. For instance prohibition or strict enforcement of clearly defined limits on lending to the Government and establishment of a consensus building mechanism between SBP and the Ministry of Finance is important. There is a need to abolish the system of automatic monetization of fiscal deficit by the SBP. The SBP Act should be changed to reflect that domestic price stability is the prime objective of monetary policy. The analysis also reveals that monetary stimulus will result in inflation unless the output capacity is not enhanced accordingly. While it is easy to increase domestic demand it is not easy to raise productive capacity to match with the surge in demand. Going forward, this fact should be kept in mind while devising monetary policy. It is important because the price stability will bring growth not the vice versa.

The coefficient of lagged call money rate $d(cmr(-1))$ is 0.002. It is statistically significant but different from 1 and is of expected sign. As mentioned in various SBP publications (such as

Monetary Policy Statements for H1 and H2 of fiscal year 2008), SBP conducts open market operations to keep the overnight rates in a band close to SBP policy rate. This systematically increases domestic credit if current interest rate is higher than previous period rate. This means that SBP is also focusing on short end of the yield curve to transmit its monetary policy signals. But result indicates that this focus on short end of yield curve is more of a recent phenomenon as indicated by recent monetary policy statements. In past OMOs were more focused on achieving quantities monetary targets rather than smoothing of short end of interest rate. If central bank can directly manage the short term interest rates, the unpredictability of money demand becomes less relevant. Instead the linkage between the short term interest rates the central bank controls and the broad range of market interest rates that affect investment and consumption decisions, as well as the linkage between the interest rates and the exchange rate becomes very crucial. Under the assumption that components of aggregate spending are more closely linked to movement in long term interest rates, monetary policy actions affecting short term interest rates are linked to the aggregate economy through the term structure of interest rates.

Conclusion:

In this chapter we looked into State Bank of Pakistan's response to the foreign exchange inflows, for the period from 2001:01 to 2007:06, to strike a balance between competing goals of internal and external equilibriums to draw lessons for its conduct going forward. In response to these inflows, central banks usually intervene in the market in response to these inflows to keep the exchange rate stable for considerations such as trade competitiveness etc. Reserves could be built but domestic money supply could also sour if these inflows remain unsterilized or only partially sterilized. Using a reaction function we tested the hypothesis that SBP fully sterilized its foreign exchange interventions. We have chosen GMM technique for estimation of the reaction

function owing to endogeneity problem between variables. The result does not support the hypothesis that the SBP fully sterilized its foreign exchange interventions. The sterilization coefficient turns out to be -0.699 (statistically different from -1) meaning that the SBP adopted a policy of partial sterilization or was unable to sterilize its foreign exchange interventions fully. More specifically, the SBP did not use domestic credit policy to attain domestic policy objectives while engaging in sterilized intervention in foreign exchange market to influence exchange rate. The coefficient of inflation 0.50 is significant, and contrary to expectations, is positive. However, this result is in conformity with the result arrived by another study by Malik and Ahmed (2010). Economic theory and SBP's mandate of price stability suggest that the sign of coefficient should be negative. That means if inflation is moving upwards, the domestic credit by the central bank need to be tightened. However, this anomaly can be explained by looking at the macroeconomic environment at 2001. Economy was in recession and inflation was subdued. The availability of excess capacity in the economy initially helped economic recovery while keeping the inflation subdued for couple of years despite expansionary monetary policy. The statistically significant coefficient (-0.002) of $IPGAP$ (representing the output gap) supports the hypothesis that during the period SBP mainly focused on the economic growth. Importantly, this coefficient has plausible negative sign. The coefficient of lagged call money rate $d(cmr(-1))$ is 0.002. It is statistically significant but different from 1 and is of expected sign. As mentioned in various SBP publications (such as Monetary Policy Statements for H1 and H2 of fiscal year 2008), SBP conducts open market operations to keep the overnight rates in a band close to SBP policy rate. This systematically increases domestic credit if current interest rate is higher than previous period rate. This means that SBP is also focusing on short end of the yield curve to transmit its monetary policy signals.

1.7: References

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1.8: Annexure 1:

Table 1.A: Economic Indicators

	Units	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08
Real GDP (fc)	%growth	1.7	3.5	4.2	3.9	2	3.1	4.7	7.5	9	6.6	6.8	5.8
Agriculture	%growth	0.1	4.5	1.9	6.1	-2.2	0.1	4.1	2.4	6.5	1.6	3.7	1.5
Industry	%growth	-0.3	6.1	4.9	1.6	4.1	2.7	4.2	16.3	12.1	5	8	4.6
Large scale manufacturing	%growth	-2.1	7.6	3.6	0.0	11	3.5	7.2	18.1	19.9	10.7	8.6	4.8
Services	%growth	3.6	1.6	5.0	4.2	3.1	4.8	5.3	5.8	8.5	9.6	7.6	8.2
Inflation (period average)													
CPI	percent	11.8	7.8	5.7	3.6	4.4	3.5	3.1	4.6	9.3	7.9	7.8	12
Food	percent	11.9	7.7	5.9	2.2	3.6	2.5	2.8	6	12.5	6.9	9.7	32
Non-food	percent	11.7	7.9	5.6	4.5	5	4.2	3.3	3.6	7.1	8.6	5.1	13.8
Core -- non-food, non-energy	percent	-	-	-	-	-	-	2.5	3.7	7	7.1	5.9	8.4
Monetary sector indicators													
Monetary assets (M2)	%growth	12.2	14.5	6.2	9.4	9	15.4	18.6	19.6	19.3	15.07	19.3	15.3
Reserve money	%growth	11.9	6.5	7.7	25.1	7.1	9.6	14.5	15.4	17.6	10.2	20.9	21.5
Private sector credit	%growth	15.9	17.0	14.2	2.7	8.1	7	20.9	33.5	34.4	23.5	14.7	16.5
Net budgetary borrowings from SBP(flows)	billion Rs	46.4	-4.5	8.9	135	-31.6	-112	-249.2	60	155.6	135.1	-58.6	688.5
SBP 3-day repo rate (end-June)	% per annum	19.0	18.0	13.0	11	14	9	7.5	7.5	9	9	9.5	12
KIBOR (6 month, period average)	% per annum	-	-	-	-	-	6.46	2.37	2.97	8.71	9.61	10.17	10.49
M2/GDP (mp)		43.4	45.1	43.6	36.6	36.2	39.6	42.6	44.1	45.6	44.9	46.6	44.7
Private sector credit/GDP(mp)		2.4	2.7	2.4	0.5	1.3	1.2	3.4	5.8	6.7	5.3	4.2	3.9
Fiscal sector indicators													
Primary balance	% of GDP	0.2	-0.1	1.2	1.5	1.7	1.9	1.2	1.6	0	-0.9	-0.1	-2.2
Fiscal balance	% of GDP	-5.3	-6.3	-5.1	-5.4	-4.3	-4.3	-3.6	-2.4	-3.3	-4.3	-4.3	-7
Total debt	% of GDP	0.0	81.8	94.4	92.9	97.7	87.8	80.1	71.4	65.7	59.7	57.9	59.7
External sector indicators													
Export	billion US$	8.1	8.4	7.5	8.2	8.9	9.1	10.9	12.4	14.4	16.4	17.3	20.1
	%growth	-2.6	4.2	-10.7	8.9	8.5	2.2	19.8	13.8	16.1	13.9	5.5	16.2
Imports	billion US$	11.2	10.3	9.6	9.6	10.2	9.4	11.3	13.6	18.8	24.6	27	35.4
	%growth	-6.5	-8.3	-6.7	-0.1	6.3	-7.8	20.2	20.4	38.2	30.9	9.8	31.1
Trade balance	billion US$	-3.1	-1.9	-2.1	-1.4	-1.3	-0.3	-0.4	-1.2	-4.4	-8.2	-9.7	-15.3
Remittances	billion US$	1.4	1.5	1.1	1.0	1.1	2.4	4.2	3.9	4.2	4.6	5.5	6.5
Current account balance	% of GDP	-4.9	-2.4	-2.7	-0.3	0.5	3.9	4.9	1.8	-1.4	-3.9	-4.8	-8.4
Foreign direct investment	million US$	682.1	601.3	472	470	322	485	798	949	1,525	3,521	5,140	5,153
Portfolio investment	million US$	267.4	221.3	27.3	-550	-141	-491	-239	314	620	986	3,283	36
REER app(+)/dep(-)	percent	-	-	-	-	-	3.3	-3.6	2.6	2	1.9	0.5	-2.3
Foreign exchange reserves (overall)	billion US$	1.2	0.9	1.7	1.4	2.1	4.8	10	11.1	12.6	13.1	15.6	11.4
weeks of imports		-	-	-	10.7	16.5	35.5	49.3	47.2	35	27.8	30.6	17

Table 1.B: Monetary Aggregates

(Flow in billion rupees)

		FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08
a.	**Net foreign assets**	**72.6**	**202.4**	**308.9**	**43.5**	**53.7**	**73.4**	**274.6**	**-316.4**
b.	**Net domestic assets**	**52.8**	**23.5**	**17.7**	**363.5**	**421.4**	**372.9**	**383.7**	**940.4**
1	Net claims on Government	-60	65.7	-69.2	57.3	91.1	86.9	92.8	583.8
	Budgetary support	-46	57.8	-46.8	62.9	67.2	67.1	102	554.6
	From SBP	*-31.6*	*-112*	*-249.2*	*60*	*155.6*	*135.1*	*-58.6*	*688.7*
	From scheduled banks	*-14.4*	*169.8*	*202.5*	*2.9*	*-88.4*	*-68*	*160.6*	*-134.2*
	Commodity operations	-12.1	5.3	-26.6	-8.2	22	19.9	-9.2	28.7
	Others	-1.9	2.5	4.2	2.6	2	-0.1	0	0.6
2	Non-Government Sector	59.9	19	126.7	315.4	418.7	408.4	385.7	441.7
	Private sector	55.6	53.2	145.9	325.2	437.8	401.8	365.7	408.4
	Claims on PSEs incl. autonomous bodies	11.9	-19.7	-11.6	-2.9	-12.7	7.6	19.7	33
	Other Financial Institutions	-7.7	-14.5	-7.6	-6.9	-6.5	-1	0.3	0.2
3	Others Items	52.9	-61.2	-39.8	-9.2	-88.4	-122.4	-94.9	-85.1
A.	**M2 (a+b)**	**125.4**	**225.8**	**326.6**	**407**	**475.2**	**446.3**	**658.2**	**624**
B.	**Reserve money**	**35.2**	**51.4**	**84.9**	**103.4**	**136.1**	**92.3**	**209.1**	**260.9**
	NDA of SBP	-2.5	-102.9	-243.4	52.9	144.7	30.5	-13.6	568
	NFA of SBP	37.7	154.3	328.3	50.5	-8.6	61.8	222.7	-307
	percent change over last year								
	M2	*9*	*14.8*	*18.6*	*19.6*	*19.1*	*15.1*	*19.3*	*15.3*
	Net foreign assets	*-164*	*714.2*	*133.9*	*8.1*	*9.2*	*11.5*	*38.7*	*-32.1*
	Net domestic assets	*3.7*	*1.6*	*1.2*	*23.6*	*22.2*	*16*	*14.2*	*30.5*
	Budgetary support	*-8.4*	*11.6*	*-8.4*	*12.3*	*11.7*	*10.5*	*14.4*	*68.5*
	Private sector credit	*8*	*7.1*	*18.2*	*34.3*	*34.4*	*23.5*	*17.3*	*16.5*
	Reserve money	*7.1*	*9.6*	*14.5*	*15.4*	*17.6*	*10.2*	*20.9*	*21.6*

Table 1.C: Balance of Payment (US$ million)

	Balance on goods, services and private transfers	Balance on capital & financial account	Balance on capital & financial account plus errors and omission*	Overall Balance**
FY92	-1346	1510	1476	130
FY93	-3688	3073	3099	-589
FY94	-1965	3471	3550	1585
FY95	-2484	2797	2722	238
FY96	-4575	4195	4144	-431
FY97	-3846	2748	2814	-1032
FY98	-1921	1268	1615	-306
FY99	-2819	-1315	-323	-3142
FY00	-1931	-2464	-1963	-3894
FY01	-513	196	822	309
FY02	1338	388	1316	2654
FY03	3028	1113	1561	4589
FY04	1300	-823	-601	699
FY05	-1807	816	736	-1071
FY06	-5683	6576	6576	1132
FY07	-6878	10449	10608	3730
FY08	-13866	8256	8359	-5507

Source: State Bank of Pakistan

Table 1.D: Financial Account (US$ million)

Items	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08
Financial account	**-1,114**	**-2,423**	**-471**	**-1,335**	**446**	**5,830**	**10,145**	**8,135**
1. Direct investment abroad	-37	-2	-27	-45	-66	-70	-114	-75
2. Direct investment in Pakistan	323	485	798	951	1,525	3,521	5,140	5,410
3. Portfolio investment	-140	-491	-239	314	620	985	3,283	36
4. Other investment	-1,260	-1,932	-1,003	-2,555	-1,633	1,394	1,836	2,764

Source: Statistics Department, SBP

Table 1.E : Cash Reserves Requirements (CRR)

With effect from	Rate as % of Time and Demand Liabilities
19-Jan-68	5
24-Oct-91	5
15-Jan-92	5
9-Feb-95	5
18-Jul-95	5
19-Dec-95	5
1-Jul-96	5
26-Jul-97	5
22-Jun-98	3.75 on Rupee and 5 on Foreign Currency
5-Sep-98	5
19-May-99	3.5
12-Jul-99	5
7-Oct-00	7
16-Dec-00	5
30-Dec-00	5
5-Jan-01	5
22-Jul-06	7 of Demand Liabilities and 3 of Time Liabilities[#]

Source: State Bank of Pakistan

Annex 2: Results of regression using output gap derived through simple linear trend.

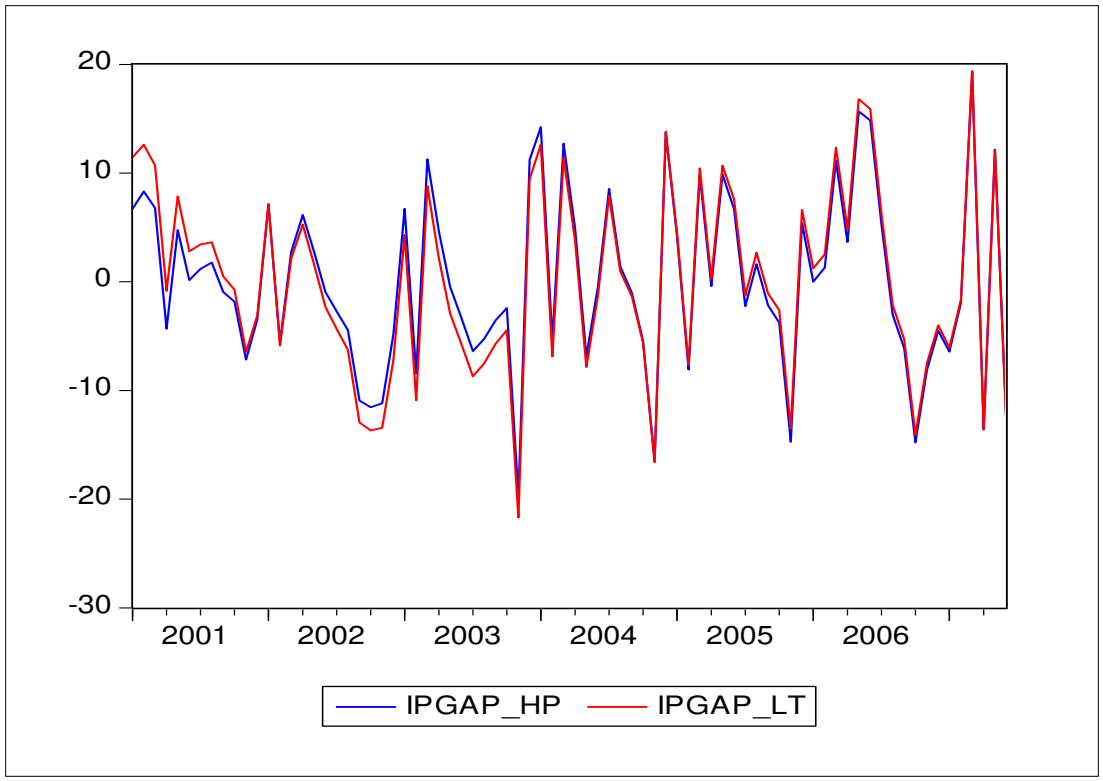

Table1.F: Estimation Results Using Linear Trend to Calculate Output Gap

	Coefficient	Std. Error	t-Statistic	Prob.
R	-0.702653	0.043340	-16.212460	0.000000
IPGAP	-0.001139	0.000241	-4.720181	0.000000
INF_M	0.450824	0.131146	3.437561	0.001100
D(CMR(-1))	0.002421	0.000618	3.914734	0.000300
R-squared	0.487851	Mean dependent var		-0.003102
Adjusted R-squared	0.459398	S.D. dependent var		0.041285
S.E. of regression	0.030355	Sum squared resid		0.049758
Durbin-Watson stat	2.133056	J-statistic		0.233127