

## **Managing Foreign Exchange Inflows: An Analysis of Sterilisation in Pakistan**

ASAD JAN, ATHER ELAHI, and M. A. ZAHID

### **I. INTRODUCTION**

A number of developing countries from Asia, Latin America and Eastern Europe have experienced surge in capital inflows during recent years.<sup>1</sup> These inflows have potential effects on macroeconomic stability; export competitiveness, and inflation. If not properly managed, these inflows can induce appreciation of local currency leading to serious repercussions for the rest of the economy. Under these conditions, the proactive role of monetary authorities in the management of capital inflows was highly desirable, wherein they intervened in the domestic exchange market in order to contain volatility in exchange rate besides accumulation of foreign exchange reserves. The main instruments available to deal with the possible effects of large capital inflows include sterilised intervention, fiscal tightening, trade and exchange liberalisation including easing controls on capital outflows. The foreign exchange interventions are typically accompanied by active sterilisation policy to keep inflation under control.

Sterilisation policy is highly effective when the capital inflows are temporary in nature. Conceptually, sterilisation is a market-based approach to neutralise (partly or wholly) the monetary impact of foreign exchange inflows. Sterilisation policy is a short-term measure, which is a “mean of buying time until the macroeconomic policies could be put to mature durable absorptions of capital flows into productive investments and augmentation of the capacity in the economy”. It also allows the policy-makers to assess the nature (transitory/permanent) of capital inflows prior to monetary policy response. Moreover, the resulted accumulation of reserves provides some degree of

Asad Jan and Ather Elahi are Analysts and M. A. Zahid is Senior Economist in the Economic Policy Department of the State Bank of Pakistan, Karachi.

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<sup>1</sup>These include India, Thailand, Malaysia, Indonesia, China, and Pakistan from Asia; Brazil and Chile in Latin America, and Poland in Eastern Europe.

cushion against a sudden reversal of inflows. However, there are certain constraints and costs of sterilisation policy, these include lack of suitable instruments, under developed domestic financial markets, large-scale quasi-fiscal deficit etc.

This study is primarily aimed at estimating sterilisation coefficient for a period between July 2000 and December 2003. This is the period when external sector witnessed heavy inflows in the form of remittances (reverse capital flight), etc. The estimation of sterilisation coefficients would help in analysing the efficacy of Central Bank's intervention in financial markets. The assessment of sterilisation has been done in the light of developing countries' experience and the study uses previously developed methodology on the subject.

The paper is organised as follows: Section II presents literature review and developing countries experiences. Section III highlights some stylised facts. Section IV deals with sterilisation in Pakistan. Section V illustrates methodology and model specifications. Section VI deals with data analysis and related issues. Section VII discusses empirical results/analysis. Conclusions and policy recommendations are given in Section VIII.

## **II. LITERATURE REVIEW AND DEVELOPING COUNTRIES' EXPERIENCES**

Central banks typically practice discretion in sterilising capital inflows (fully/partially) to offset the expansionary impact of foreign exchange interventions. Though effectiveness of sterilised intervention is very controversial; some professionals debated in favour of sterilisation other renounced it. However, sterilisation remained a preferred policy option for immediate response to temporary capital inflows.

Altinkemer (1998) estimated the sterilisation coefficient for Central Bank of Republic of Turkey (CBRT) by dividing the estimation period into two sub-periods, February 1990-October 1993 and April 1994-June 1998. Using OLS technique, it was found that CBRT sterilisation coefficient was 1.04 and 0.93 for the first and second periods respectively. Another study on the same subject by Celasun and Denizer (1999) computed the sterilisation coefficients based on the methodology of Cumby and Obstfeld (1983). They estimated Net Domestic Assets (NDA) by using 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.<sup>2</sup> For the whole period, the sterilisation coefficient was found as (-) 0.37, which indicated partial sterilisation of 37 percent of reserve inflows (given that lags of NFA proved insignificant).

<sup>2</sup>NDA including revaluation account and adjusted for reserve requirements.

Government Deficit including instrumental variables; constant, monthly dummies, three lags of the dependent and conditioning variables, 6 lags of net foreign assets, uncovered interest parity and three lags of it.

Kouri and Porter (1974) and Obstfeld (1982) pointed out that the offset coefficient is subject to a possible sterilisation bias.<sup>3</sup> The source of the bias is the possible endogeneity of NDA. If capital inflow is systematically sterilised, the change in NDA will be correlated with the disturbance term in the NFA equation (or capital-flow equation), therefore OLS estimates will be inconsistent. To remedy this problem, Argy and Kouri (1974) suggested that the offset and sterilisation equations be estimated by two-stage least squares using instrumental variables.

Siklos (1997) found that Central Bank of Hungary (NBH) fully sterilised capital inflows during 1990–95 and the sterilisation coefficient thus found was 1.002 by using OLS method.

Miller and Askin (1976) 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 regression 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 both countries completely sterilised the effects of payments imbalance on their monetary base.

Besides individual research studies, the episode of capital inflows for some Asian economies and their responses in terms of sterilisation have also been reviewed as a reference for analysing sterilisation experience of Pakistan. The findings are illustrated as follows:

India has experienced huge capital inflows during recent years, which led to build-up of foreign exchange reserves. The Reserve Bank of India (RBI) intervened in the foreign exchange market actively in order to contain volatility, manage liquidity in the system and ensure exchange rate and price stability. The RBI used various available instruments for sterilisation. Open Market Operation (OMO) was used as the main instrument of sterilisation for out right sale of government securities. Liquidity Adjustment Facility (LAF) was utilised to supplement OMOs to absorb excess liquidity by way of repo conducted by RBI for overnight, 7 days, and 14 days. Empirical estimation of sterilisation coefficient for India stood at (–) 0.83 during 1994-03 showing that the RBI was able to sterilise 83 percent of the impact of foreign exchange inflows. (Table 1.)

Malaysia, like other emerging market economies, experienced huge capital inflows in the form of portfolio and foreign direct investment, which started in 1989. Bank Negara Malaysia actively intervened in the foreign exchange market, which led to a substantial increase in its foreign exchange reserves.<sup>4</sup> These

<sup>3</sup>Offset coefficient is the changes in foreign exchange reserves (NFA) are explained by the variations in net domestic assets (NDA). De Grauwe (1975).

<sup>4</sup>The cumulative inflows were recorded to US\$ 26 billion during 1989-93 compared to US\$ 17 billion during the 80s. Foreign exchange reserves increased from US\$ 7.4 billion in 1989 to US\$ 26.8 billion in 1993.

Table 1

*Cross-Countries Comparison*

Countries	Sterilisation Coefficient	Sample Period	Frequency
India*	-0.83	1994-03	Monthly
Pakistan	-0.87**	Jul 00 – Dec 03	Monthly
Korea	-0.90	1980-89	Monthly
Brazil	-1.76	1955-71	Yearly
Chile	-1.22	1955-71	Yearly
Hungary	-1.00	1992-97	Monthly

\*RBI report on Money, Credit and Prices.

\*\* From Equation-1.

reserves led to increased liquidity and raised inflationary pressures in the Malaysian economy. Hence, the government used sterilised intervention.<sup>5</sup> Overall, Bank Negara Malaysia absorbed 24 billion ringgit from the banking sector through sterilisation measures in 1992, equivalent to 90 percent of the outstanding stock of reserve money.

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 offset the monetary impact of foreign exchange interventions through sterilisation. Kim (1991) estimated 90 percent sterilisation of increase in net foreign assets during the 1980s.

Indonesia has experienced massive capital inflows during early 90s mainly in the form of long-term borrowing.<sup>6</sup> To avoid abrupt appreciation of Indonesian Rupiah in the face of massive inflows of foreign capital, Bank Indonesia purchases foreign currency from the market and the resultant excess liquidity of Rupiah was absorbed through sales of short-term central bank securities (Sertifikat Bank Indonesia, SBI) and money market securities (Sural Berharga Pasar Uang, SBPU). Similarly, other measures like direct controls on credit expansion and restrictions on foreign capital inflows were taken to control excess liquidity.

<sup>5</sup>The main instruments used in 1991-92 were OMOs and changes in the statutory reserve requirement (SRR). In addition to that, foreign loans related to swaps and foreign borrowing from offshore financial markets added to the list of liabilities subject to reserve requirements. However, monetary sterilisation resulted in a persistent rise in domestic interest rate, which attracted additional foreign capital and further necessitate sterilisation intervention. For this purpose, Bank Negara Malaysia introduced the Bank Negara Bills (BNB) and the Malaysia Saving Bond (MSB) in 1993 to absorb excess liquidity from the market. Moreover, Bank Negara Malaysia took six administrative measures in 1994 to restrain destabilising impact of capital inflows on the economy.

<sup>6</sup>Both public and private sector borrowing. The surge in these external borrowing was attributable to high domestic interest rate in early 90s, removing ceiling on foreign commercial borrowing by banks in 1989 and introduction of swaps facility with the Central Bank of Indonesia. The inflows recorded at US\$ 34 billion during 1990-94 compared to US\$ 25 billion in 1980-89.

Thailand started experiencing large inflows of foreign capital during late 80s in the form of long-term loan, FDI, portfolio investment and other foreign investment (OFI).<sup>7</sup> A policy mix was used to manage the excess liquidity in the market and stabilise the interest rate. Therefore, intervention in the repurchase market for government and state-enterprise bonds and issuance of central bank securities have been the main tools of monetary sterilisation.

An analysis of cross countries experience of managing foreign capital inflows shows that Brazil, Chile and Hungary went for complete sterilisation whereas Korea, India and Pakistan opted for partial sterilisation (Table 1).

### III. STYLISTED FACTS

Pakistan has experienced significant inflows of foreign capital during the period under study, having severe repercussions particularly on exchange rate if not managed properly. Therefore, SBP (Central Bank) intervened in the foreign exchange market and purchased excess supply of foreign exchange approximately US\$ 6.8 billion equivalent to around Rs 400.5 billion (see Table 2) during the period. However, NDA of the SBP was reduced by Rs 309.7 billion, indicating that 77.3 percent of the liquidity injected as a result of purchases of foreign exchange was sterilised.

Table 2

<i>Forex Purchased and Change in NDA</i>			
Period	Net Forex Purchases	Change in NFA	Change in NDS
FY01	1,031.7	37.7	-6.9
FY02	3,858.7	150.5	-96.9
FY03	4,975.3	328.3	-161.7
Jul-Dec 03	884.5	86.1	-44.2
Total	10,750.2	602.6	-309.7
Liquidity Injection into the Market through Forex Purchases			Rs 400.5 Bn
Neutrality of Forex Purchases by corresponding reduction in NDA			77.3%

*Source:* Monetary Survey (SBP).

Similarly, the commercial banks' holding of market treasury bills' (MTBs) increased by Rs 313.7 billion (approximately) from Rs 103.8 billion (end June 2000) to Rs 416.9 billion (end December 2003). Hence, it pointed out that sterilisation during this period was 78.3 percent (see Table 3) by keeping in view foreign exchange purchases of Rs 400.5 billion during the period under study.

<sup>7</sup>These inflows were mainly due to high interest rate in Thailand compared to industrial economies and government permission to exporters to receive payment from non-resident Baht accounts so to minimise the foreign exchange risk. Other foreign investment (OFI) is the sum of short-term borrowing by commercial banks and non-resident Baht deposit account.

Table 3

*Commercial Banks MTBs' Holding*

End Period	MTBs' Holding
June-00	103,790
Jun-01	123,989
Jun-02	231,507
Jun-03	411,254
Dec-03	416,932
Commercial Banks' Holding of MTBs by during Jul-00 to Dec 03	Rs 313.71 Bn
Liquidity Injection via Forex Purchases	Rs 400.5 Bn
Sterilisation	78.3%

These two assumptions build up a back ground that the Central Bank neutralised the monetary impact of capital inflows through off-loading government securities from Central Bank to Commercial Banks. Therefore, this thesis will be proved in the next sections (regression analysis).

#### IV. STERILISATION IN PAKISTAN

In the recent years particularly after 9/11 events, Pakistan experienced excessive foreign exchange inflows especially sharp rise in remittances. These unprecedented foreign exchange inflows had implications for conduct of monetary policy, money supply, inflationary pressure and undue appreciation of Pak rupee. State Bank of Pakistan (SBP) responded to the challenge. A prudent monetary policy was followed which helped in keeping a balance between massive foreign exchange inflows, stable exchange rate, lower interest rates and price stability. Through its effective sterilisation policy, SBP had successfully managed to offset the expansionary effects of foreign capital inflows particularly on reserve money (RM), money supply (M2) and exchange rate. SBP also availed the opportunity to accumulate foreign exchange reserves because one of the most important lessons learnt from Asian crisis was that countries with weak reserve position were more likely to be hit by speculative attacks. Foreign exchange reserves improved significantly from \$2.0 billion at end-June 2000 (equivalent to 10 weeks' of imports) to \$12.17 billion at end-December 2003 (equivalent to 50 weeks' of imports). Pakistan's comfortable reserve position has contributed to stabilising exchange rate, enhancing investors' confidence, reducing external vulnerability, and also in improving Pakistan's credit rating by international credit rating agencies. Pakistan was also able to pre-pay expensive debt of ADB amounting to \$1.17 billion.

The supply position of foreign exchange was so comfortable in both the markets (Inter-bank and open markets) that in order to avoid any abrupt appreciation of Pak rupee, SBP had to intervene in the foreign exchange market and had to mop up excess foreign exchange supply and consecutively injected rupee liquidity into the banking system. SBP made net purchases of US\$ 6.8 billion during July 2000 to December 2003 and injected Rs 400.5 billion (approx.) into the banking system. SBP used the sterilisation policy to resist the inflationary pressures, which is associated with the expansion of money supply. The liquidity injections were largely mopped up through Treasury Bills (TBs) auctions.

**Impact of Sterilisation**

Since RM is operational target for perusing monetary policy and also it is monetary base through which banking system creates credit and expands liquidity, a rise in RM without any offsetting measure (sterilisation) leads to automatic expansion in money supply. Since sterilisation has direct impact on RM and money supply, it has effected reduction in NDA of SBP through offloading government papers held by it to the scheduled banks (see Figures 1, 2, and 3). Consequently, increase in NFA was offset by corresponding reduction in NDA so that reserve money remained on target. If the reserve money were not curtailed through sterilisation, the M2 would have grown sharply having severed implications for the economy in terms of higher inflation and erosion in Pakistan’s export competitiveness. By checking the unusual growth of money supply, sterilisation has also helped in containing inflation.

**Fig. 1. Sterilisation Effect on M2**

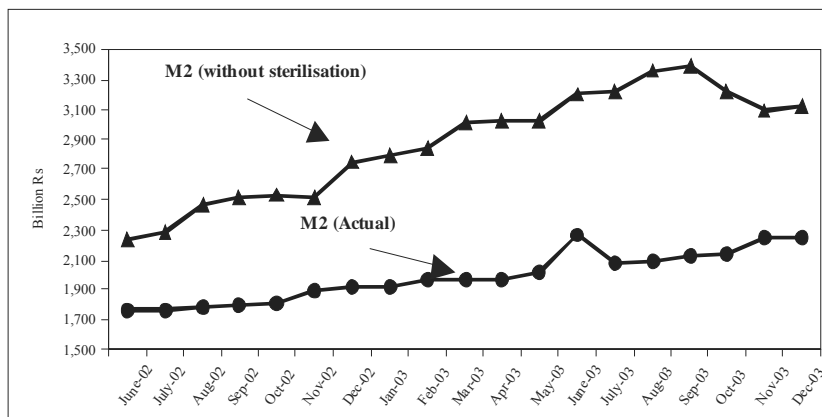


Fig. 2. Sterilisation Effect on RM

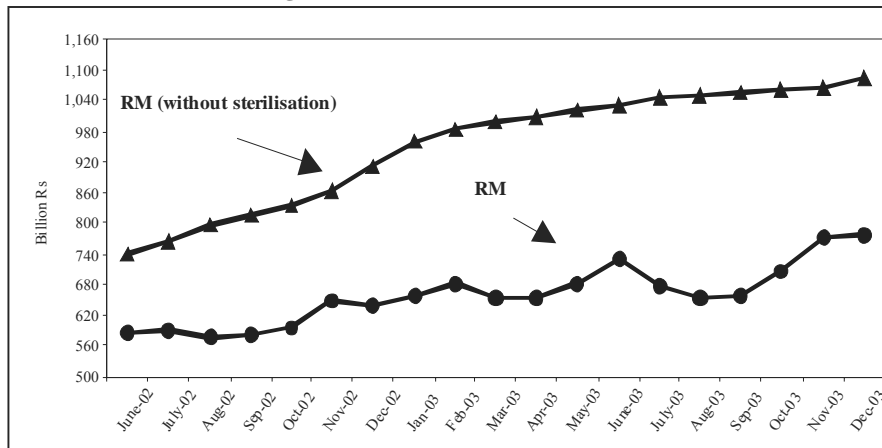
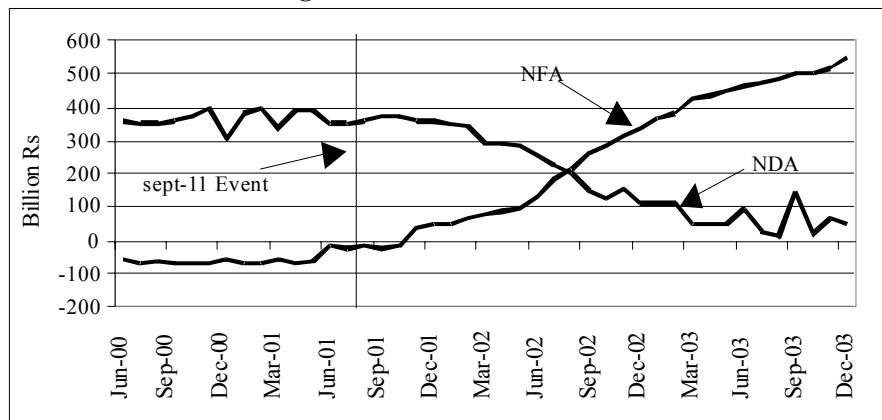


Fig. 3. Trend in NFA and NDA



SBP intervention to sterilise has arrested the abrupt appreciation of Pak rupee. However, SBP allowed gradual appreciation of Pak rupee. Otherwise, it would have eroded the Pakistan's export competitiveness in the international markets and also have damaged the export-oriented industries leading to rise in unemployment. Appreciation of Pak rupee slowed down from 6.8 percent in FY 02 to 3.9 percent in FY 03 which turned into depreciation of 0.6 percent in FY 04.

Sterilisation involves some cost which has to be borne by the SBP. It is the difference between higher earnings foregone on offloaded T-bills and lower returns on SBP investment of foreign exchange. Moreover, SBP has also to bear the loss due



to increase in the revaluation cost resulting from appreciation of Pak rupee against US dollar. Resultantly, it has reduced the profit of SBP from Rs 36.1 billion in FY 00 to Rs 21.3 billion in FY 01 and further to Rs 0.243 billion in FY 03. However, the macro-benefits in terms of lower borrowing cost for the government as well as private sector, low inflation, and maintenance of export market share outweighed the cost of low profitability of the SBP.

**V. METHODOLOGY AND MODEL SPECIFICATION**

Monetary authorities typically sterilise the monetary impact of the balance of payment by changing their domestic assets according to the following,

$$\Delta DA_t = Z_t - \alpha(CA_t + K_t) \dots \dots \dots (1)$$

- $\Delta$  represents change in the variable
- $DA$  is the domestic assets of the Central Bank
- $Z$  is a vector of variables affecting monetary policy
- $(CA+K)$  is the balance of payment (current account +capital account)
- $t$  is the time period
- $\alpha$  is the co-efficient represents the degree of sterilisation.

On the balance sheet of a central bank the Net Foreign Assets (NFA) depicts foreign capital flows while credit expansions is reflected through Net Domestic Assets (NDA), therefore, the above phenomenon can also be expressed by using balance sheet terminology as follows:

$$\Delta NDA_t = C + \gamma_1 \Delta NFA_t + \varepsilon_t \dots \dots \dots (1a)$$

- $NDA$  is the net domestic assets of Central Bank
- $NFA$  is the net foreign assets of the Central Bank
- $C$  represents the constant
- $\gamma$  indicates the degree of sterilisations
- $\varepsilon$  is an error term.

Further, contemporaneous output gap and inflationary expectations played vital role in the capacity utilisation and investment decisions of business enterprises. Therefore, credit expansion may also be influenced by these variables. Alternatively, we can expand Equation (1a) as follows:

$$\Delta NDA_t = \gamma \Delta NFA_t + \eta (y - y^*) + \delta \pi_t + \mu_1 \dots \dots \dots (2)$$

- $(y - y^*)$  is the gap between current output and its potential level
- $\pi$  denotes inflation

“ $\gamma$ ” represents degree of sterilisation, which is expected to be negative. If it is not significantly different from  $-1$ , the sterilisation is full, while if it is greater than  $-1$  and less than zero, sterilisation is only partial. An offset sterilisation can also be identified by inverting Equation (2) through endogenous capital flows, which effect NFA.<sup>8</sup> The relevant empirical literature suggests that the degree of sterilisation varies among different countries and over time i.e. full sterilisation in some countries while partial in others.

In this study, we are using monthly data for period of three years, so it is very difficult to find out monthly Gross Domestic Product (GDP) hence Industrial Production Index (IPI) is used as a proxy for GDP. Therefore Equation (2) can be re-written as

$$\Delta NDA_t = \gamma_t \Delta NFA_t + \eta_1 \Delta IPIsa_{t-i} + \delta_1 \Delta CPI_{t-i} + \mu_2 \quad \dots \quad \dots \quad (3)$$

*IPIsa* is seasonally adjusted Industrial Production Index

*CPI* is the consumer price index

The model is further extended by incorporating other variables like nominal exchange rate (ER US\$/Rs), domestic interest rate (6-month treasury bills rate) and foreign interest rate (LIBOR) as capital flows are very sensitive to volatility in such variables and resultantly domestic credit in an open economy is influenced by developments in domestic economy as well as the rest of the world. Therefore, Equation (3) can be further extended as follows:

$$\Delta NDA_t = \gamma_1 \Delta NFA_t + \eta_1 \Delta IPIsa_{t-i} + \delta_1 \Delta CPI_{t-i} + \beta \Delta ER_{t-i} + \alpha Diff_{t-i} + \mu_3 \quad (4)$$

Where

*Diff* represents interest rate differential (6-month T-Bills minus Libor)

*ER* is the exchange rate

$$-1 \geq \gamma_1 \leq 0$$

$$\eta_1 > 0$$

$$\delta_1 < -1$$

$$\beta > 0$$

$$\alpha > 0$$

And, *Diff*. Represent interest rate differential (6-month TBs rate minus 6-month LIBOR).

## VI. DATA ANALYSIS AND ISSUES

For empirical analysis, monthly data, ranging from July 2000 to December 2003, has been used, thus giving 42 observations. The choice of the sample

<sup>8</sup>The issue was first discussed by Kouri and Porter (1974) in the context of an open-economy general equilibrium model of international capital flows determination where capital flows are essentially seen as the mechanism by which a domestic excess demand for money is removed.

period is mainly due to, firstly, favourable current account position during the sample period, secondly, switching over to marker-based exchange rate mechanism during July 2000, thirdly, inflow of foreign capital in term of workers' remittances, foreign grants and aid, IFIs loan increased particularly after September 11 events, fourthly, purchase of foreign currency by SBP both from inter-bank and Kerb markets etc.

Time series properties of the macroeconomic variables were analysed, which narrated that most of the variables are non-stationary at level and depict trend over time. The non-stationary series become stationary when difference  $d$  time is said to be integrated of order  $d$  i.e.  $Z_t \sim I(d)$  and combination of these variables are co-integrated when one or more linear combinations are detected. For the purpose, Augmented Dickey-Fuller (ADF)/Phillips Perron test is used to check the stationary condition of the variables. The ADF test shows that all the variables, except interest rate differential (6-month TBs rates *minus* Libor), are non-stationary at level (see Table 4), however variables becomes stationary at first difference and the order integration is 1, i.e.  $Z_t \sim I(1)$ . Industrial Production Index (IPI) has been used as a proxy due to unavailability of Gross Domestic Production (GDP) data on monthly basis. Moreover, IPI series has also been adjusted for seasonal variations and first difference was taken to remove stationarity. Similarly, consumer price index is used in the analysis, which is non-stationary at level and stationary at first difference. For calculating interest rate differential 6-month treasury bill yield (weighted average) was taken as a benchmark interest rate for domestic economy while 6-month LIBOR was representing foreign interest rates in this analysis. Interest rate differential is stationary at level (10 percent significance level) using Phillips Perron test. In the same way, the exchange rate of US dollar against domestic currency (PKR) was also non-stationary at level; therefore, first difference has been used for analytical purposes.

Table 4

*Augmented Dickey-Fuller (ADF) Test*

Variables	Value at Level	Value at First Difference*	Level of Integration
NDA	-1.4815	-7.4784	I(1)
NFA	4.2860	-3.1240	I(1)
CPI	4.8792	-3.8858	I(1)
ER	-1.3452	-3.5338	I(1)
IPISA	0.2906	-8.1168	I(1)
Interest Rate Differential	-3.2032**	-	I(0)

\*Mackinnon critical values for rejection of hypothesis of a unit root.

\*\*Phillips Perron at 10 percent.

Ordinary least square (OLS) method was used as the sample period was not sufficient long for estimating more sophisticated econometric models. However, in order to avoid any tendency of spurious regression all series were made stationary using standard unit root tests i.e. Augmented Dickey Fuller and Phillips-Perron test. Stability tests were also applied to check the robustness of estimated models, while residual tests were used for analysing white noise properties of the estimated coefficients.

## VII. EMPIRICAL RESULTS AND ANALYSIS

The empirical results suggest that a significant amount of sterilisation has been taken place during the sample period. The extent of sterilisation is indicated by the coefficient of  $\Delta NFA_t$ .

$$\begin{aligned} \Delta NDA_t &= 3.653 - 0.875\Delta NFA_t - 1.2495MA(1) \\ &\quad (11.62) \quad (-16.50) \quad (-8.21) \quad \dots \quad \dots \quad \dots \quad (5) \\ Adj R^2 &= 0.71 \quad \quad \quad DW = 1.76 \end{aligned}$$

Equation (5) indicates a partial sterilisation of about 87 percent (sterilisation coefficient is  $-0.87$ ) by keeping all other variables constant. The autocorrelation in the model is removed by taking first order moving average ( $MA(1)$ ); however there is no problem of heteroscedasticity and the variance is constant over time. The standard stability test (Cusum test) qualified the robustness of the model. The skewness, kurtosis and hypothesis test (Jarque-Bera) suggest normal distribution of the model.

$$\begin{aligned} \Delta NDA_t &= 7.374 - 0.857\Delta NFA_t - 10.576\Delta CPI_{t-6} - 0.453MA(1) \\ &\quad (1.646) \quad (-5.237) \quad (-2.602) \quad (-2.332) \quad \dots \quad (6) \\ Adj R^2 &= 0.58 \quad \quad \quad DW = 1.89 \end{aligned}$$

Equation (6) explicitly incorporates consumer price index ( $CPI$ ) and Industrial Production Index ( $IPI$ ) into the model. However, these variables are insignificant and of incorrect signs at level. An attempt was made to adjust the seasonal pattern in  $IPI$  by using ratio to moving average method (multiplicative) before estimation, which again lead to same results. Alternatively,  $IPI$  was dropped from the equation while  $CPI$  was estimated at lag 6. Resultantly,  $CPI$  became significant at 1.0 percent with correct sign. Equation (6) also illustrates the partial sterilisation of 86 percent ( $-0.86$ ), which is almost the same as indicated by Equation (5).

$$\begin{aligned} \Delta NDA_t &= -0.704\Delta NFA_t - 12.994(di - li) - 0.734\Delta IPI_{t-2} - 46366.6\Delta ER_{t-1} \\ &\quad (-16.08) \quad (-2.97) \quad (-2.29) \quad (-4.32) \\ &\quad - 0.965MA(1) \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (7) \\ &\quad (-13.77) \\ Adj R^2 &= 0.70 \quad \quad \quad DW = 1.94 \end{aligned}$$

Equation (7) further disintegrates the impact of capital flows on domestic credit in terms of interest rate differential (6-month TBs rates minus 6-Month Libor), nominal exchange rate along with CPI and IPI. The empirical result suggests that exchange rate, *IPI* and interest rate differential are significant and their signs contradict to economic theory. According to this equation, 70 percent of the increase in net foreign assets has been sterilised during the sample period.

Granger Causality test was used to find out causal relationship between NDA and NFA. The estimated result illustrates that causation is uni-directional i.e. from NFA to NDA during the sample period up to lag 5 (see Table 5).

Table 5

*Pair-wise Granger Causality Tests*

Sample Range: 2000:06 2003:12			
Lags: 5			
Null Hypothesis	Obs	F-Statistic	Probability
NFA does not Granger Cause NDA	38	2.7139	0.0412
NDA does not Granger Cause NFA		0.2708	0.9251

By looking into the Akiake info and Schwarz criterion, it is clear that the simple model is more robust among the three different equations (see Table 6). It implies that SBP policy is mostly near to neutralise the capital inflow. And further, these estimates suggest that the SBP used domestic credit policy to attain internal policy objectives while engaging in sterilised intervention to check the exchange rate equilibrium.

Table 6

*Model Selection*

Criteria	Equation 1	Equation 2	Equation 3
Akaike info Criterion	8.6393	8.8107	8.9343
Schwarz Criterion	8.7768	9.0042	9.1679

**VIII. CONCLUSION AND RECOMMENDATIONS**

SBP had successfully managed the massive foreign exchange inflows in the recent years particularly after 9/11 events. Sterilisation policy proved effective in offsetting the expansionary impact of these foreign exchange inflows on reserve money (RM), money supply (M2), exchange rate and prices. The sterilisation coefficient for Pakistan during July 2000-December 2003 has been empirically estimated at (-) 0.87 which, indicates that 87 percent increase in NFA, was effectively sterilised. SBP intervened in the foreign exchange market to prevent Pak rupee from undue appreciation. For sterilisation, SBP relied on outright sale of government securities (mainly T-Bills) through auctions. It was supplemented by

OMOs to manage liquidity in the banking system. However, SBP left enough money in the market to push a downward pressure on domestic interest rate in order to boost and maintain the momentum of economic growth. Pakistan availed effectively the opportunity for building-up foreign exchange reserves and for pre-payment of expensive debt of \$1.17 billion owing to ADB.

Keeping in view the experience of various countries in managing the capital flows the following recommendations are made:

- (1) The sterilisation through Auctions/OMOs for enduring period is not feasible because of limited stock of Government Securities held with the monetary authority. Therefore, alternative instruments should be explored. SBP may consider issuing its own short-term paper to mop-up excess liquidity from the market.
- (2) There is a need to promote the depth of financial markets especially a well-organised foreign exchange market to absorb foreign exchange inflows in a smooth manner without allowing adverse impact on exchange rate and price stability.
- (3) Liquidity-forecasting framework should be further strengthened to assess the short-run liquidity position in an objective manner, so that pro-active and timely decisions could be taken to avoid liquidity crisis.

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## **Comments**

The paper deals with sterilisation of foreign currency inflows in the recent pass. The study is important in the sense that past few years have seen a dramatic surge in capital inflows. I commend the authors for taking a timely study. I would like to make a few observations.

### **Data Span**

To justify the data span the authors state on that “This is the period when external sector witnessed heavy inflows in the form of remittances” I am afraid that the statement does not hold as far as the first year of the data span viz. 2000-01 is concerned. In year 2000-01 remittances were a mere 1.08 billion, only 100 million higher than previous year and only 28 million higher than FY 98-99. Thus remittances till FY 2000-01 were following the trend course. It was only after 9/11 that we saw a quantum jump in remittances. So this statement needs to be corrected for the purpose of record.

### **Data**

The Table 2 shows under net forex purchases a figure of 1.12 billion with a negative sign. This implies that during FY 01 SBP was net seller of foreign currency in the foreign exchange market. Had this been the case NFA should have declined but the very next column shows an increase of 37.7 billion in NFA. My feeling is that NFA figures reported are correct but perhaps inadvertently the authors have not included the purchases of forex from the open market in net foreign exchange purchases. However this would not affect the econometric results as the data included in estimation of regression is that of NFA. However if purchases from the open market are included the net forex purchases during the data span would be around 10.7 billion rather than 6.8 billion mentioned in the study. If the authors insist that the data of net forex purchases is correct than it is difficult to comprehend why FY 2000-01 has been included in the data span, because when SBP is selling foreign currency in the forex market the question of sterilising inflows does not arise.

### **Stationarity**

On p.16 it is stated that in order to avoid any tendency of spurious regression, all series were made stationary using standard unit root test. The unit root test only provides information that whether or not a series is stationary. It does not make a series stationary. It's the differencing that makes the series stationary.

**Methodology**

On p.18 it is stated that Engle-Granger causality test was used. Is it simply the Granger causality test or Engle-Granger causality test as mentioned in the paper? The paper just mentions that uni-directional causality from NFA to NDA is observed. They have neither indicated the regression estimated nor the estimation results of the causality.

**OLS**

The authors have acknowledge that OLS is not the ideal methodology to estimate the model due to simultaneity in the model but they contend that other sophisticated methodologies cannot be used due to the shorter data span. The authors state that in order to avoid the problem of spurious regression all series were made stationary. Differencing the series takes a lot of information content from the series that if included would influence the coefficients. Given this limitation that the results need to be viewed with caution.

**Seasonality**

As the data used is monthly, the possibility of seasonality in data exists. The authors have used seasonally adjusted data series for the industrial production index. It is not clear why other series have not been seasonally adjusted or alternatively why seasonal dummies have not been used.

**Conclusions of the Paper**

The conclusions of the study should flow from the study itself. Conclusions mentioned in the study are basically policy implications of the result. The one mentioned at serial 1 states that the sterilisation through Auction/OMOs for the ensuing period is not feasible because of limited stock of government securities held with the monetary authority, therefore alternative instrument should be explored. Not much has been said in the body of the paper regarding the stock of securities available with the monetary authority. Similarly it is difficult for the reader to draw the conclusion, by just reading the paper, that the liquidity-forecasting mechanism need to be strengthened to assess the short run liquidity position. The authors need to say something more about this in the body of the paper, linking this with the effects of sterilisation.

**Muhammad Idrees Khawaja**

Pakistan Institute of Development Economics,  
Islamabad.