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Instrument of Managing Exchange Market Pressure: Money Supply or Interest Rate

M. IDREES KHAWAJA and MUSLEH-UD DIN

1. INTRODUCTION

Exchange market pressure (*emp*) reflects disequilibrium in money market. The traditional approaches used to examine the disequilibrium in money market include the monetary approach to balance of payments and monetary approach to exchange rate. Under the former approach the variation in foreign reserves helps restore the equilibrium while under the latter one the change in exchange rate does the needful.¹

The idea of this study stems from the fact that under the managed float exchange rate regime, changes in foreign reserves or changes in exchange rate in isolation are not a sufficient guide to characterise the external account situation of an economy. For example, exchange rate depreciation can be partially avoided or at least delayed if the central bank injects foreign currency in the forex market by letting its foreign reserves deplete. Alternatively, central bank can build up foreign reserves by purchasing foreign currency from the market against domestic currency. Such intervention would curb the exchange rate appreciation demanded by fundamentals. Therefore, focus on either of the two, that is, movement in exchange rate or variation in foreign reserves, to the complete exclusion of the other, is bound to portray a misleading picture of the external account situation. Given the foregoing a composite variable, that incorporates changes in exchange rate as well as variation in foreign reserves, over a certain period, is needed to characterise the condition of external account. The requisite composite variable has been developed by Girton and Roper (1977) as ‘simple sum of exchange rate depreciation and variation in foreign reserves scaled by monetary base’. They refer to it as exchange market pressure (*emp*).

This study uses the composite variable *emp* rather than foreign reserves or exchange rate, to examine the interaction between monetary variables and external account. Specifically the study employs Granger Causality test to examine the nature of influence of monetary variables *viz.* domestic credit and interest rate upon exchange market pressure and vice versa. The analysis is likely to facilitate monetary management. The study also seeks to determine whether the instrument of domestic credit or interest

M. Idrees Khawaja <khawjami@yahoo.com> and Musleh-ud Din <musleh.ud@gmail.com> are respectively Consultant and Dean, Faculty of Economics, at the Pakistan Institute of Development Economics, Islamabad.

¹For further exposition of the mechanism that restores equilibrium under different exchange rate regimes, see Frenkel (1976), Mussa (1976), and Pilbeam (1999).

rate has been used by the authorities to manage exchange market pressure. The use of domestic credit implies quantitative monetary management i.e. directly varying the level of money supply whereas the use of interest rate implies market-based monetary management. The two monetary regimes carry different implications for the economy.

The study is organised as follows: Section 2 is devoted to review of literature on *emp* model, Section 3 shows the theoretical framework for the study, Section 4 concerns data issues, Section 5 reports and analyses the results from econometric investigation and Section 6 concludes.

2. LITERATURE REVIEW

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

2.1. Girton and Roper's *emp* Model

Girton and Roper (henceforth GR) contend that equilibrium in domestic money market is achieved through movement in exchange rate and foreign reserves. Excess domestic money demand causes the exchange rate to appreciate or the foreign reserves to increase or some combination of the two. Similarly excess money supply causes the exchange rate to depreciate or the reserves to decline or some combination of the two.

Under the GR formulation of *emp* model, the exchange market pressure is a function of three variables viz. growth in domestic credit, growth in foreign money supply and the differential between growth in domestic and foreign real income. The authors assume that, demand for money is stable (i.e. money multiplier is held constant), purchasing power parity holds, money market enjoys flow equilibrium and that the differential between domestic and foreign interest rate remains constant.

The distinguishing features of GR's monetary model of balance of payments (BOP) include; one, the dependent variable is exchange market pressure, defined as the sum $r + e$, rather than the BOP *per se*, second, GR's model holds for all exchange rate regimes (of the dependent variable $r + e$, r and e are respectively zero, under floating and fixed exchange regimes, rest of the model remains unchanged). Third, the model views a country's monetary policy as tight or loose only in a relative sense i.e. by reference to the monetary policy, generally, being practiced in rest of the world.

The extensive applications of the GR model include, Cannolly and Silveira (1979) to Brazil, Paradhan, *et al.* (1989), to India, Modeste (1981) to Argentina, Kim (1985) to Korea and Wohar and Lee (1992) to Japan, Thornton (1995), Tanner (2001) for six East Asian countries, Kamaly and Erbil (2000) for three MENA region countries, Tanner (2002) for 32 countries and Bautista and Bautista (2005) for Philippines.

The recent *emp* models assume a small open economy and thus step aside from monetary dependence apparent in GR's model. In recent models foreign shocks influence the domestic economy through change in interest rate differential and inflation differential while in earlier models external shocks are transmitted to the domestic

economy through growth in foreign money supply. The recent models have also relaxed the assumption that purchasing power parity holds. Another improvement effected at empirical stage in recent studies is that the use of VAR methodology takes care of the endogeneity in the *emp* model, that earlier studies failed to tackle. Till Thornton (1995) the *emp* model was primarily used only to validate the monetary approach however recent studies also tend to examine whether the tool of monetary policy, *vis-à-vis* exchange market pressure, has been domestic credit or interest rate.

Kamaly and Erbil (2000), Tanner (2001, 2002) and Bautista and Bautista (2005) have examined Granger causality between exchange market pressure and monetary variables using the *emp* model. The results vary across the countries examined and it is difficult to develop a common argument from the results examined.

3. THEORETICAL AND EMPIRICAL FRAMEWORK

3.1. The Model

To examine Granger causality between exchange market pressure and monetary variables, we use a model similar to the one used by Kamaly and Erbil (2000), Tanner (2001, 2002) and Bautista and Bautista (2005). The model is:

$$emp_t = dc_{t-j} + i_{t-j} + y_{t-j} + z_{t-j} + \pi_{t-j}^* \quad \dots \quad \dots \quad \dots \quad \dots \quad (1)$$

Where:

- emp_t : Exchange Market Pressure at time t ,
- dc_t : Growth in domestic credit (scaled by monetary base),
- y_t : Growth in real income,
- i_t : Growth in nominal interest rate,
- π_t^* : Growth in international inflation,
- z_t : Deviation from Purchasing Power Parity,
- J : Number of lags.

3.2. Theoretical Underpinnings of the Model

Domestic Credit: Positive Relationship with EMP

The positive influence of domestic credit upon exchange market pressure has roots in monetary approach. The approach posits that excess money supply will be corrected by way of deficit on BOP while surplus on BOP will take care of the excess money demand. Under the fixed exchange rate regime the adjustment burden, falls on foreign reserves, under free float; on exchange rate and both the foreign reserves and exchange rate share the adjustment burden under managed float. The adjustment proportion is determined by the monetary authority in its own discretion.

Given the above an increase in domestic credit causes the exchange rate depreciate or foreign reserves to flow out or some combination of the two, that is, increase in exchange market pressure. Hence the positive impact of change in domestic credit upon exchange market pressure.

Interest Rate: Positive Relationship with EMP

Keynesian theory of money demand holds that interest rate bears negative relationship with money demand. The following flow chart shows the channel through which interest rate exercises influence upon exchange market pressure.

Increase in interest rate → decrease in real money demand (leading to excess supply) → Foreign reserves outflow/exchange rate depreciation → increase in exchange market pressure.

We predict a positive relationship between interest rate and exchange market pressure. Frenkel (1979) discusses conflicting views, *viz.* Chicago view and Keynesian view regarding the relationship between interest rate and exchange rate. The essence of Chicago view is indicated in the flow chart given above i.e. the increase in interest rate causes the money demand to decline which in turn causes the exchange rate to depreciate. This view predicts negative relationship between interest rate and exchange rate. The Keynesian view argues that increase in domestic interest rate given foreign interest rate makes the domestic securities more attractive. This attracts foreign capital into the country that causes the foreign reserves to increase and exchange rate to appreciate. Thus Keynesian view predicts a positive relationship between interest rate and exchange rate (i.e. increase in interest rate would lead to appreciation of exchange rate). The view assumes perfect capital mobility and one condition for capital mobility is that domestic and foreign securities should be equally risky.

To assess the applicability of Keynesian channel in Pakistan let us assume that interest rate in Pakistan is sufficiently higher than that in US. Can we expect that Americans will transfer money from their banks in US to banks in Pakistan? Certainly not, the reason is that money in Pakistani banks is not considered as safe as in US. As Pakistani securities are perceived more risky relative to foreign ones therefore we do not expect the Keynesian view to hold in Pakistan. Given the non applicability of the Keynesian view we feel that only the Chicago view is at work in Pakistan and therefore we posit a positive relationship between interest rate and exchange market pressure.

3.3. Hypotheses

We test the following hypotheses using Granger Causality²

- dc_t causes emp_t
- emp_t causes dc_t
- i_t causes emp_t
- emp_t causes i_t

The Granger Causality has been estimated using the following:

$$\dot{Y}_t = \sum_{j=1}^k A_j Y_{t-j} + X_t \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (2)$$

²For technical details of Granger Causality consult Gujrati (1998).

Where Y is a vector of (emp , dc , i and y) endogenous variables and X is a vector of (z_t , π_t^*) of exogenous variables.

4. THE DATA

4.1. Data Span

Data span of the study is: 1991:04-2005:12. Given that exchange market pressure model is particularly applicable to managed float (though it is possible to use the model for other exchange rate regimes as well), therefore one logical starting point of the data span is January 08, 1982—the day Pakistan adopted managed float. However we use 1991 as the starting point because of the following. Prior to March 1991 interest rate was regulated by SBP, interest rate on Government Treasury Depository Receipts (GTDRs), whose features are similar to that of Treasury Bills now in vogue, was changed only once during the eight years preceding March 1991. This is enough to conclude that interest rate was not being used as an instrument of monetary policy prior to 1991. Our objective being to determine whether the dominant tool of monetary policy *vis-à-vis* exchange market pressure is ‘interest rate’ or ‘domestic credit’, we cannot include data prior to March 1991. Hence the small sample of 14.9 years that we have. Besides we use three sub-spans spanning over 7.2, 7.7 and 4.4 years. The characteristics of these sub-spans are indicated in Table 1 below.

Table 1

Data Span: Characteristics

From	To	Peculiarity	Length (Years)
1991:04	2005:12	Initiation of the move towards market based monetary policy (Full span)	14.9
1991:04	1998:05	Life period of Foreign Currency Deposits (FCDs)	7.2
1998:06	2005:12	Post-FCDs freeze / 9/11	7.7
2001:09	2005:12	Post 9/11	4.4

The motivation for the full span of 14.9 years has been discussed above. The motivation for the sub spans follows:

4.1.1. Sub-spans: 1991:04-1998:05 and 1998:06-05

Foreign Currency Deposit Accounts (FCDs) during their short active life (1991-98)³ had been not only a key source of foreign currency for the authorities but had led to *dollarisation* as well. Both in turn influenced exchange market pressure and the monetary policy. The developments call for analysis of the relationship that prevailed between the exchange market pressure and the monetary variables. Secondly in May 1998, as Pakistan

³Fresh foreign currency accounts with banks were allowed shortly after the freeze on FCDs in May 1998. However given the confidence shattering freeze, the fresh accounts have failed to mobilise the volumes that characterised the FCDs during 1991-98. Therefore we refer to the time period (1991-98) as active life of FCDs.

went Nuclear, foreign aid sanctions were imposed on Pakistan. The post-freeze/post-sanctions span will allow us to examine as to how the authorities managed the pressure in the crises period.

4.1.2. Sub-span: 2001:10-2005:12

Certain events triggered by 9/11 led to dramatic reduction in exchange market pressure. It is important to see how the monetary policy reacted to the change in the direction of exchange market pressure. Hence we use the data-span 2001:09-2005:12.

4.2. Frequency

Data frequency is monthly. The motivation for using high frequency data is that the data among others, includes, domestic credit, interest rate, exchange rate and foreign reserves. These variables have dynamic properties that can be best captured with high frequency data. Besides, as mentioned above, we have a relatively small sample of 14.9 years. Given the small sample size, the use of annual data is ruled out for reliable econometric investigation. Similarly, the smaller sub-spans, referred above, rules out the use of quarterly data as well.

4.3. Variables

The variables included in the empirical model given by Equation (2) are: Exchange Market Pressure (emp_t), Domestic Credit (dc_t), Interest rate [Six month T-bill rate: (i_t)], Real income [Proxy: Industrial production (y_t)]⁴, International inflation [Proxy: U.S. inflation (p^*_t)] and Deviation from purchasing power parity (z_t).

Of the six variables mentioned above, data for the series' i_t , y_t and p^*_t are directly available in published statistics while data for the series dc_t , emp_t , and z_t is to be generated. This in turn requires data on some more variables. (The generation of the series' is discussed in Annexure A). In all we require data on: nominal exchange rate, foreign reserves, Industrial production index, domestic credit, interest rate and CPI (US and Pakistan). The data has been obtained from International Financial Statistics (IFS) CD-ROM (May 2006).

4.4. Stationarity

All the data series have been tested for absence of unit root. The tests employed include Dickey Fuller/ Augmented Dickey Fuller (ADF) and the seasonal unit root test proposed by Baeulieu and Miron (1993). We employ the seasonal root test because the monthly data is more prone to seasonality. The ADF test as well as the seasonal unit root test shows that all the series exhibit stationarity. The result is not surprising as the model employs all variables in growth form.

5. ESTIMATION OF THE EMP MODEL

To conduct the Granger causality test we have estimated Equation 2 using appropriate restrictions depending upon the hypothesis to be tested. Before estimating

⁴Monthly data on real income is not available. The use of industrial production as proxy for real income is well established.

Equation 2 we have determined the lag structure of the variables using the standard AIC method. Besides we have additionally ensured that residuals of the concerned regressions do not exhibit serial correlation. The foregoing process delivers the lags mentioned against the respective data spans in Table 2.

Table 2

Data Spans: Lags of Dependent Variables for VAR System

	Interval	Duration: No. of Years	Lags of Dependent Variable
Full Span	1991:04-2005:12	14.9	4
Post Liberalisation	1995-2005	11	3
FCD Span	1991-04-1998-05	7.2	2
Post FCD Freeze/Post-aid sanctions/ 9/11	1998:06-2005:12	7.7	2
Post 9/11	2001:09-2005:12	4.4	2

Granger causality test results for the hypotheses indicated in section 3.3 are reported below in Table 3 below.

Table 3

Granger Causality Test: Results

Null Hypothesis	OMOs				
	Full: 91:04- 05:12	FCD: 91:04- 98:05	Initiation 95-05	FCD-Freeze 98-05	9/11 01:10-05:12
dc_t causes emp_t	no (1.37)	no (0.74)	no (0.31)	yes (2.40)	yes (3.87)
emp_t causes dc_t	no (0.87)	no (1.86)	no (0.69)	no (1.10)	no (0.66)
i_t causes emp_t	no (0.79)	no (0.48)	no (1.35)	no (1.10)	yes (2.11)
emp_t causes i_t	yes (4.03)	yes (2.48)	yes (3.25)	no (0.21)	no (0.51)

F-statistics in parenthesis.

5.1. Causality from Domestic Credit to Exchange Market Pressure⁵

As evident from Table 3 the test results show that domestic credit causes exchange market pressure in the Granger-sense only in the post FCD freeze and post 9/11 span. The causality from domestic credit to exchange market pressure observed during the two spans implies that volume of domestic credit, during the two period referred above, has at

⁵Before we discuss the results from Granger causality test it is important to emphasise that Granger causality does not essentially imply economic causality [Hamilton (1994)]. For example expectations of changes in reserves could cause domestic credit to change. This would cause domestic credit to change today, so that the Granger causality would seem to run from domestic credit to reserves but the true causality goes from expectations of reserves to domestic credit.

least partially been determined by the level of upcoming magnitude of exchange market pressure. In other words monetary policy has been influenced by exchange market pressure considerations. An evidence of this is the intervention activity of the central bank in the forex market from 1999-04. The exact year-wise volume of intervention during these years is indicated below in Table 4.

Table 4
Purchase /Sale of Foreign Currency by SBP

Period	US \$: in Millions		
	Interbank (Net)	Kerb Purchases	Net Addition FR*
1999-2000	-797.0**	1633.4	836.4
2000-2001	-1125.6**	2157.3	1031.7
2001-2002	2483.0	1375.7	3858.7
2002-2003	4546.0	429.3	4975.3
2003-2004	896.8	0.00	896.8

Source: SBP annual reports (various reports).

* FR stands for foreign reserves.

**The negative sign with the figures indicates sale of foreign currency.

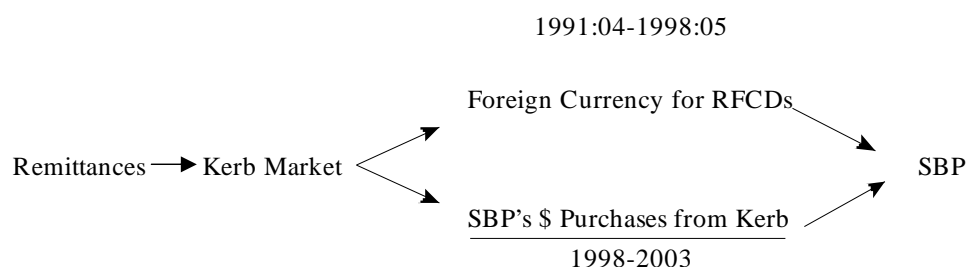
The intervention activity for the period 1999-00 to 03-04 can be separated into two sub-periods with opposing exchange market pressure scene. The objectives of intervention in the two periods are discussed below.

The first period, starting with May 1998 reflects the period when economic-aid sanctions were imposed on Pakistan in the wake of going Nuclear then. The foreign reserves held by the central bank stood at a relatively level low of \$1.28 billion and the foreign currency accounts with commercial banks stood freezed i.e. depositors were not allowed to encash their deposits in foreign currency.

Under the foreign currency deposits (FCDs) scheme initiated in March 1991 the residents were allowed to hold foreign currency accounts with commercial banks. The foreign currency mobilised by banks under the scheme was surrendered to SBP against Rupee equivalent. Thus the foreign currency deposits used to augment the foreign currency resources at the disposal of central bank, though technically the deposits were not a part of foreign reserves. As the FCDs mobilised by banks were surrendered to SBP therefore the foreign reserves were a natural hedge against default on foreign currency deposits. Upon imposition of sanctions in May 1998, with foreign reserves at a rather low level and prospects of improvement in foreign reserves being rather dim, due to aid sanctions, it was but logical for the people to expect that the government/SBP will not be able to fulfill its obligation regarding the redemption of FCDs.

In the light of the above, the government feared a run on foreign currency deposits. To cope with the situation the government imposed a freeze on foreign currency deposits. The foreign currency account holders were allowed to withdraw only Rupee equivalent of the foreign currency held in their accounts. The default on the part of the government, to redeem FCDs in foreign currency besides shattering the confidence of the depositors had an adverse impact on foreign investment as well.

The following flowchart indicates the mechanics as to how remittances at different times had fed the foreign reserves.



The flow chart, shows that FCDs were merely a channel of transferring remittances from the kerb market to the SBP. The freeze on FCDs closed the channel for such transfers. The premium between open market exchange rate and the official exchange rate being rather high at that point in time (i.e. May 1998), the inflow of remittances through formal banking channel was not expected then.⁶ Under the given scenario the SBP purchased foreign currency in exchange for domestic currency, from the kerb/inter bank market in 99-00 and 00-01 to bolster its depleted reserves. The purchase obviously resulted in expansion of domestic credit. This shows that the increment in reserves, resulting from expansion in domestic credit, relieved the exchange market pressure. Thus exchange market pressure consideration led to expansion in domestic credit or in other words monetary policy became subordinate to external account situation.

The intervention activity undertaken post 9/11 was undertaken in an entirely different backdrop. Post 9/11 the exchange market pressure in Pakistan improved dramatically. The substantial improvement in exchange market pressure was mainly due to three reasons: (i) quantum jump in remittances from overseas Pakistanis, (ii) Reprofile/waiver of foreign loans, and (iii) some improvement in macroeconomic fundamentals. Table 5 gives an idea about the extent of improvement in exchange market pressure.

Table 5

<i>Exchange Rate Appreciation and Increase in Foreign Reserves</i>			
	Sept. 2001	Dec. 2003	Appreciation/Increase
Exchange Rate	RS. 64.20	RS. 57.21	12 %
Foreign Reserves	\$2,149	\$10,941	409 %

In just two months since 9/11 the exchange rate had appreciated by 5.2 percent and the foreign reserves had registered an improvement of almost 50 percent over the figure just prior to 9/11. The appreciation of exchange rate was hurting the export competitiveness of the country. Given this the authorities decided to stall/slowdown the appreciation of exchange rate. Consequently the central bank purchased foreign currency to the tune of \$9.7 billion from July 01- June 04 (Table 4), from the interbank as well as

⁶As the open market exchange rate was at a premium over the official rate, the conversion of \$s into Rupees yielded more Rupees in the open market. Therefore the overseas Pakistanis preferred to send money through the informal channel (i.e. *hundi*) instead of remitting it through banks. The foreign currency thus remitted ended up in the open market rather than in SBP.

the kerb market, in exchange for domestic currency, thereby increasing domestic credit (money supply). Thus once again domestic credit was used to manage exchange market pressure—this time to contain the appreciation of Rupee rather than manage an increase in foreign reserves. The foregoing discussion shows that, domestic credit was extensively used to manage exchange market pressure. The following statement included in SBP annual report confirms the point.

Over the last few years, while monetary policy gained a degree of independence from fiscal policy, it remained captive to the exchange rate considerations. Interestingly, these shackles persisted through the whole of FY02 despite the current account surpluses seen post-September 2001, which led to a considerable appreciation of the Rupee. However, the focus changed dramatically during the year as the emphasis shifted from preventing a *depreciation* of the Rupee, to avoiding a very abrupt *appreciation* (SBP Annual Report: 2001-02).

Thus the central bank followed a proactive monetary policy to stall the appreciation of Rupee, that is, in anticipation of the expected level of exchange market pressure the central bank changed the level of domestic credit to manage exchange market pressure.

5.2. Causality from Exchange Market Pressure to Interest Rate

Now we take up the causality observed from exchange market pressure to interest rate during the FCD span. For the interest rate channel to work some avenue is needed through which foreign funds may flow. Foreign currency accounts had been the said avenue during the period 1991:04 to 1998:06. With the freeze on foreign currency accounts in May 1998 the avenue stood closed and hence the absence of causality from exchange market pressure to interest rate for the spans that encompass post FCDs-freeze period. To substantiate our point we present a comparison of yield on FCDs and deposits denominated in domestic currency in Table 6.

Table 6

Yield Comparison: FCDs and Domestic Deposits

Year	(1)* Avg. Return on FCDs	(2) Exch.Rate Depreciation	(3) =(1)+(2) FCDs Yield *	(4)* Wtd. Avg. Rate on Domestic Deposits	(5) T.Bill Rate (6 months)
91-92	6.0	3.42	9.42	7.59	12.22
92-93	6.0	8.08	14.08	7.70	12.43
93-94	6.0	12.70	18.70	8.04	10.96
94-95	6.0	1.31	9.31	8.18	12.73
95-96	6.0	13.19	19.19	8.24	13.03
96-97	6.0	15.27	21.27	8.49	16.05
97-98	6.0	13.69	19.69	8.38	15.70

Note: The average rate on Defense Savings Certificate (DSC) was 13.8 percent however this includes the rate on DSCs of longer term maturity (5-10 years) whereas the FCDs were mainly of short-term maturity.

* SBP annual report 97-98 p.116.

** SBP statistical handbook.

The data in Table 6 shows that yield on FCDs was always above the weighted average rate paid on deposits denominated in local currency and was also more often greater than average return on Defence Savings Certificates—the highest yield securities denominated in local currency.⁷

From 1991 to 1998, the exchange market pressure had generally been positive and relatively higher, during this period the interest rate had also exhibited a rising trend. The causality from exchange market pressure to interest rate leads us to infer that during the years the authorities used the interest rate to defend the Rupee. Remittances from overseas workers after having reached a peak of \$2.8 billion in 1982 had started tapering-off. To cope with the shortage of foreign currency the government allowed the residents to hold foreign currency accounts. The yield on FCDs being higher than the deposits denominated in domestic currency, there was trend among residents to hold their savings as FCDs for which the foreign currency was being purchased from the kerb market. It is noteworthy here that the non-resident FCDs that were allowed in 1991 stood at \$6.9 billions at the time of freeze in 1998. The dollarisation, in this manner, increased the demand for foreign currency in the open market and there by led to the depreciation of Rupee. To avoid importing inflation the SBP had to defend the Rupee by increasing the return (interest rate) on domestic assets [Mirakhor and Zaidi (2006)]. Thus the exchange rate depreciation, a component of exchange market pressure, led to increase in interest rate. This explains the Granger causality from exchange market pressure to interest rate during the FCD span. The impact of the causality observed in the FCD span (a sub-span) is strong enough so as to make it observable in the full span as well.

5.3. Causality from Interest Rate to Exchange Market Pressure

Causality from interest rate to exchange market pressure is observed in the post 9/11 span. 9/11, for reasons outlined earlier, did cast a favourable impact upon the exchange market pressure, at least, in the immediate future. Post 9/11, the external account position improved dramatically; the foreign reserves registered a quantum jump and the exchange rate was on an appreciation for the first time in Pakistan's history. Given the exchange rate appreciation and the comfortable foreign reserves position the need to defend the Rupee was no longer there. Therefore the central bank could afford to practice a loose monetary policy, which otherwise was also required to give a much needed boost to the economy, and this is what the central bank actually did, as the interest on 6-months treasury bills declined by 929 basis points in 22 months (Oct. 01-July 03). Thus the improvement in exchange market pressure led to the decline in interest rate. This point of view is supported by the following excerpt from SBP annual report:

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

Given this we should have observed the causality from exchange market pressure to interest rate in the post 9/11 span, however, in practice the causality observed is the

⁷To make the comparison between returns on FCDs and domestic instruments more meaningful it is note worthy that unlike FCDs domestic instruments were subjected to taxes and Zakat deductions. Accounting for such deduction would make the return on domestic instrument lesser than that shown in the Table 6.

other way round. The reason lies in the fact that the post 9/11 span encompasses a period of 52 months in total out of which the interest rate was on a downward course for the initial 22 months only. For the remaining 30 months (Aug.03-Dec.05), interest rate followed an upward path and the exchange rate after ending the appreciation spell in December 2003 was on the depreciation course for remaining 2 years of the post 9/11 data span. Thus it was the upcoming pressure on exchange rate that forced the SBP to raise interest rate—to defend the Rupee. This suggests that we should be able to observe causality from interest rate to exchange market pressure in the post 9/11 span, as in practice is the case. Having described above the possibility of causality in two opposing directions, the fact that causality observed during the post 9/11 span is from interest rate to exchange market pressure and not the other way round implies that the depreciation pressure on exchange rate since January 2004 outweighed the positive effect of exchange rate appreciation during the earlier part of the span so that the ultimate causality observed, during the span is from interest rate to exchange market pressure.

6. CONCLUSION

The magnitude of exchange market pressure carries implications for the level of inflation and host of other macroeconomic variables. Given this the authorities tend to manage exchange market pressure. The instruments used range from quantitative controls to influencing the level of interest rate or money supply. The use of interest rate implies greater reliance on the market forces and the tilt of the managed float towards floating exchange rate regime while the use of money supply implies more reliance on the monetary authority and tilt of the managed float towards fixed exchange rate regime.

We have examined the interaction between exchange market pressure and monetary variables viz. interest rate and domestic credit (reserve money) using Granger causality test. Causality in the Granger sense is observed from exchange market pressure to interest rate during the active life of FCDs (1991-98). However the instrument of managing exchange market pressure seems to have undergone a change with the freeze on FCDs as causality from interest rate to exchange market pressure has been replaced by causality from domestic credit to exchange market pressure in the post FCD freeze span and post 9/11 span.

During the active life FCDs (1991-98) *dollarisation* led to depreciation of Rupee that in turn contributed to inflation. To avoid importing inflation the SBP had to defend the Rupee with the increment in interest rate. With the freeze on FCDs, *dollarisation* came to a grinding halt therefore the increment in interest was no more needed to defend the Rupee. However the low level of foreign reserves forced the authorities to resort to outright purchase of foreign currency from the open market thereby increasing domestic component of money supply. Thus the instrument of managing exchange market pressure changed from interest rate to money supply. Post 9/11 given the unanticipated foreign inflows SBP purchased foreign currency from the market to maintain competitiveness of our exports—again using money supply to manage the exchange market pressure. Thus the use of monetary instrument *vis-à-vis* exchange market pressure has varied with need of the day. However the use of interest rate being a consequence of FCDs and *dolarisation* only, it is mainly the money supply that is ordinarily used to manage exchange market pressure.

ANNEXURE - A**Domestic Credit**

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

- Reserve Money
- Foreign Reserves
- Nominal Exchange Rate

Exchange Market Pressure

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

- Nominal Exchange Rate
- Foreign Reserves
- Reserve Money

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

Deviation from Purchasing Power Parity

As explained earlier under theoretical framework deviation from purchasing power parity (PPP) is to be worked out as per Equation (A-1) which after slight algebraic manipulation is reproduced below for ready reference.

$$z_t = e_t + \pi_t^* - \pi_t \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (A-1)$$

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

- Nominal Exchange Rate
- International Price Level (Proxy: US CPI)
- Domestic Price Level (CPI).

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