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Abstract

This study employs Siregar and Pontines (2007) measure of Exchange Market Pressure Index (EMPI), a weighted average of exchange rate changes, reserve changes, and interest rate changes on monthly basis for period from Jul-1995 to Dec-2008 in Pakistan. One of the well-known uses of the index i.e., determining a threshold level for signal of pressure is also demonstrated. We identify twenty four signals of exchange market pressure during study period, ten of which were in a short period of three years, (FY96 to FY98). In order to address these pressures, government of Pakistan signed six programs with IMF during the period under review. The study also examines the relationship between EMPI, inflation, current account balance, and domestic credit. The results show that inflation, domestic credit and current account balance have significant effects on the exchange market pressure index. Within the domestic credit, the government sector credit significantly affects the EMPI.

JEL Codes: *F31; F41*

Keywords: *Exchange market pressure; exchange rate; threshold level,*

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1. Introduction

The economy of Pakistan has faced several episodes of pressure on its foreign exchange market due to various economic imbalances as well as external factors; most recent of which was felt during November 2006 to October 2008. The aforementioned period witnessed a huge depletion of Pakistan's foreign exchange reserves stemming from a large current account deficit. During this period, the rupee came under a lot of pressure with a depreciation of over 25 percent against US$. The foreign exchange market condition improved only after Pakistan entered into an IMF Stand-By Arrangement in November 2008, and the SBP took corrective measures.[1] Consequently, Pak rupee recovered some of its earlier losses against the US dollar and registered a net appreciation of 7.45 percent during Oct-Mar FY09. By June 30, 2009 Pak rupee depreciated by 19.2 percent as compared to its value in the beginning of FY09. On the face of it, foreign exchange reserves showed an increase of US$ 1267 million during the same period. However, if we exclude the IMF money received as part of the SBA, the foreign exchange reserves actually declined by US$ 2632.8 million during FY09. Before deciding about how to respond[2] to the pressure of excess demand for foreign exchange, it is important to quantify the degree of exchange market pressure. Realizing its importance, in this paper we have attempted to construct exchange market pressure index for Pakistan.

In case when pressure on exchange rate mounts, this index can also serve as an indicator of the degree of currency crisis in the economy, if any. Besides current account imbalance, the gap in financial account also affects the movements in the exchange rate. The financial account is influenced by the domestic interest rate viz-a-viz foreign interest rate(s); however, this depends upon the degree of capital mobility in the country. If exchange market pressure suggests that country is moving towards currency crisis, the monetary authority needs to respond by at least one of the two ways: accommodate the pressure by running down on its international reserves, and/or deter the attack by raising policy interest rate. During January 2005 to October 2007, the exchange rate in Pakistan remained fairly stable at around Rs. 61/US$ which coincided with a steady interest rate differential between weighted average

[1] These measures included suspension of forward booking of dollars and reduction in trading time. SBP also issued instructions to exporters to submit their overdue export proceeds. The SBP has imposed an LC margin of 100 percent on the import of non-essential and luxuries items such as luxury vehicles (jeeps & cars) above 1800 cc, etc.

[2] The decision whether to let foreign exchange reserves deplete or to let value of nominal exchange rate depreciates, is largely dependent upon the exchange rate regime, the degree of misalignment in the real effective exchange rate and the necessity to correct the misalignment.

overnight repo rate and Federal Funds Rate. We define Exchange Market Pressure (EMP) index as a weighted average of exchange rate changes, reserve changes, and interest rate changes on monthly basis in line with Siregar and Pontines (2007). The EMPI can be constructed at higher frequency (e.g., weekly or daily) and can be used to track attacks on exchange market in future.

In addition to constructing EMP index, the present study also defines a threshold level of this index to reflect the pressure in the market and explore for the determinants of the exchange market pressure in Pakistan. The outline of the study is as follows. Section 2 presents the literature review regarding analysis and construction of exchange market pressure index. The definition, methodology and the selection of the threshold level for exchange market pressure is discussed in Section 3. This section also presents the functional form of determinants of EMPI. The key results and main findings are presented in Section 4. The paper ends with a summary of key findings in section 5.

2. Literature review

Although there is considerable literature on construction and analysis of exchange market pressure index in case of many developed and developing countries, there is hardly any study for Pakistan with the exception of Khawaja (2007) which examines the interaction between exchange market pressure and monetary variables. The study suggests that domestic credit has remained a leading instrument of monetary policy for managing exchange market pressure in Pakistan. The author also notes that interest rate remained less effective as a tool of monetary policy during the period of 1991-98 when foreign currency deposits were popular. The finding implies that a reasonable degree of capital mobility is required in the economy for the effective working of interest rate as monetary policy tool vis-a-vis exchange market pressure.

In case of other countries, a study by Kumah (2007) for Kyrgyz Republic is a recent example. It characterizes the exchange market pressure as a nonlinear Markov-switching phenomenon, and examines its dynamics in response to money growth and inflation over three regimes. The empirical results recognize episodes of exchange market pressure in Kyrgyz Republic and confirm the statistical superiority of the nonlinear regime-switching model over a linear VAR

version in understanding exchange market pressure. The author argues that during period of appreciation pressure, however, the reverse policy option (monetary expansion) may not be efficient. In addition, monetary expansion in such cases defeats the primary objective of monetary policy (price stability) and may intensify the instability.

Early construction of a single crises index known as the exchange market pressure (EMP) index has largely been based on the fluctuations of the real or nominal exchange rate of a currency against the US dollar, the most commonly accepted anchor currency in international market. Hardly any study has however tested the sensitivity of this crisis index to the choice of different "anchor" currencies. Siregar and Pontines (2007) consider the EMP indices of Indonesian rupiah, Malaysian ringgit and Thailand bath constructed by adopting three different exchange rates (real effective exchange rate, the local currency against US$, and the local currency against the Japanese yen) for the period of 1985-2003. The test results indicate that the reported incidences of speculative attack are highly sensitive to the choice of anchor currencies.

Fontaine (2005) empirically tests the implication of a number of theoretical models on 37 countries including 16 emerging economies that attempt to highlight the dynamics behind currency crises and determines the extent to which these variables matter in affecting the probabilities of occurring of currency crises. The experiences of several emerging market economies suggests that the sustainability of exchange rate policy depends both on adequate policy responses to the shocks to the economy and on the fragility of economic, financial, and political system.

According to Tanner (2000), the exchange market pressure generally refers to movements in international reserve holdings and exchange rate, the excess supply of money in a managed exchange rate regime. He also examines how exchange market pressure is affected by monetary policy in Brazil, Chile, Mexico, Indonesia, Korea and Thailand. The monetary policy stance is best measured by domestic credit growth (since interest rate contains both policy and market determined elements). In response to higher EMP, monetary authorities boosted domestic credit growth both in Mexico and in Asian countries.

Kaminsky and Reinhart (1999) analyze the links between banking and currency crises in OECD countries and finds that problems in the banking sector normally lead to currency crises. The currency crises intensify the banking crises, activating a cruel corkscrew; financial liberalization often precedes the banking crises. The anatomy of these episodes suggests that crises occur as the economy enters a recession, following a prolonged boom in the economic activity that was fueled by credit, capital inflows, and accompanied by an overvalued currency.

Another study by Kaminsky et al. (1998) examines the empirical evidence on currency crises in 20 countries including 15 developing economies, and recommends an explicit early warning system. This system involves the monitoring of the evaluation of many indicators showing abnormal behavior in the periods before a crisis. When an indicator goes beyond a certain value, it indicates a warning "signal", which may accentuate within the next 24 months. The exports, deviation of real exchange rate from trend, the ratio of broad money to gross international reserves, output, and equity prices are the variables that have best track record regarding the currency crises approach.

Weymark (1997) has formally demonstrated that calculation of exchange market pressure and the degree of intervention are sensitive to the nature of intervention activities. In a two-country world, exchange market pressure and intervention indices depend on changes in bilateral exchange rate, changes in official reserves, exchange rate-related domestic credit changes, and all of structural parameters of both economies. Moreover, the functional form of the indices used to measure exchange market pressure and intervention activities depends on whether intervention is direct or indirect, and also on whether foreign exchange reserves are held exclusively in the form of bonds.

Frankel and Rose (1996) use a panel data of over 100 developing countries including Pakistan from 1971 to 1992 to characterize the currency crashes, defined as a large depreciation of the nominal exchange rate. They find that output growth, the rate of change of domestic credit, and foreign interest rate are significantly related to currency crashes. A low ratio of FDI to debt is consistently associated with a high likelihood of a crash.

Based on evidence from 20 OECD countries, Eichengreen et al. (1996, 1996) addresses the fact that incidences of speculative attacks tend to be temporally correlated; that is, currency crises appear to pass "contagiously" from one country to another country. In this study he also demonstrates that the existence of a currency crisis elsewhere in the world raises the probability of an attack on the domestic currency by eight percent, even after taking account of a variety of domestic political and economic factors.

Kim (1985) has applied a monetary model of exchange market pressure to the Korean experience under a managed floating exchange rate system, which showed that there is strong evidence of a negative relationship between rate of domestic credit creation and the rates of change in exchange market pressure. The Korean experience indicates that most of exchange market pressure is absorbed by the adjustments in foreign reserves that are consistent with the government's wariness of inflation and of the debt burden effects of exchange rate devaluation.

Hodgson and Ronald (1981) examines the stability of relationship between monetary magnitudes and exchange market pressure in seven advanced countries (Canada, UK, France, Germany, Belgium, Netherland and Switzerland) and establishes that the coefficients of the money demand variables are generally not significant. Of the money supply variables, coefficients of the rates of change in the home money multiplier and domestic credit are almost always significant and have signs as predicted by the monetary approach. Test for stability explains that the relationship between exchange market pressure and excess demand for money within an economy may not be stable overtime.

Connolly and Jose (1979) tests the Girton-Roper monetary model in Brazil for the period of 1955-1975 and concludes that domestic credit is consistent with the monetary model of exchange market pressure, the price and income coefficients are not significant for this period, but are from 1962 to 1975. He also tests the hypothesis that implied tradeoff between reserve losses and exchange depreciation for the monetary authorities is one to one. In over two decades (1955-75), the monetary authority of Brazil has excellently alleviated exchange market pressure by a combination of foreign exchange reserves changes and exchange rate depreciation.

Griton and Roper (1977) develop a monetary model to explain both exchange rate movements and official intervention. The dependent variable (exchange market pressure) provides a measure of the volume of intervention necessary to achieve any desired exchange rate target. The model is applied to the postwar Canadian experience and is found that exchange market pressure is not sensitive to its composition. This implies that movement in exchange rate and reserves can be used to determine the volume of intervention necessary to achieve various exchange rate targets.

The above review of literature evolved the whole process of development in measuring exchange market pressure index, the threshold level of EMPI, sensitivity in the selection of anchor currencies, and interaction of EMPI and economic variables such as interest rate, current account balance, fiscal balance, central bank intervention in forex market etc. in different economies for different period. The study by Khawaja (2007) for Pakistan uses only two variables i.e. exchanges rate and foreign exchange reserve for calculating EMPI, while ignoring the interest rate variable. The present study incorporates interest rate and its dynamics in developing exchange market pressure index for Pakistan.

3. Definition and measure of exchange market pressure

Pressure in the foreign exchange market may be marked as a tendency for the exchange rate depreciation or appreciation. Exchange market pressure also shows the magnitude of disequilibrium in the money market. It is important to mention here that exchange market pressure not only identifies the successful attack (when a significant large depreciation of currency occurs), but also recognizes the unsuccessful attack (pressure rebuffed by loss in the reserve and/or rise in interest rate). Usually, the exchange market pressure index (EMPI) is constructed by incorporating two of the following variables, viz. exchange rate, international reserves and interest rates. Griton and Roper (1977) develop EMPI by combining exchange rate depreciation with reserve changes. Kaminsky and Reinhart (1999), Glick and Hutchison (2000) and Edison (2003) also construct EPMI by using the two variables (without interest rates). Khawaja (2007) also develops EMPI by using foreign reserves and nominal exchange rate. While Eichengreen et al. (1995) argues that interest rate is the response of the central bank in exchange crisis and should be included in the computation of EMPI. Nitithanprapas and Willett (2000), Bordo et al. (2001), Bussiere and Fratzscher (2002), and Siregar and

Pontines (2007) include all the three variables to construct the EMPI. In EMPI, weighting scheme to be used for variable is still controversial. For example, Griton and Roper (1977), based on the use of monetary model, weight exchange rates and reserve changes equally, while Eichengreen et al. (1995, 1996) develops the "precision weighting scheme in which the inverse of each component's variance served as the weight in EMPI". This weighing scheme equalizes the volatilities of changes in exchange rates, reserves and/or interest rates, which has become the most commonly used approach. The measurement of exchange market pressure index in this study is based on the following formula used by Siregar and Pontines (2007).

$$EMPI = \frac{\Delta e}{e_t} - \frac{\sigma_e}{\sigma_r}\frac{\Delta r}{r} + \frac{\sigma_e}{\sigma_{int}}\Delta_{int} \qquad (1)$$

Where EMPI is the exchange market pressure index; e_t the units of currency per US dollars; σ_e the standard deviation of the rate of change in the exchange rate[3] $(\Delta e|e_t)$; r_t the gross foreign exchange reserves; int_t the nominal interest rate; σ_r the standard deviation of the rate of change in reserves $(\Delta r|r_t)$ and σ_{int} the standard deviation of the change in interest rate.

In equation 1, different weights were assigned to key components of exchange market pressure. In particular, the weights for interest rate and reserves fluctuations depend on the relative size of their standard deviation (σ_{int} and σ_r respectively) against that of the exchange rate (σ_e). EMP index increases with a depreciation of domestic currency, a loss of international reserves and a rise in the domestic interest rate. As the excess demand of foreign currency prevails in the economy, central bank sells foreign currency by drawing down its international reserves. As a result, upward pressure exists in the exchange market. A tight monetary policy, which widens the spread between domestic and foreign interest rate, encourages the capital inflow and thereby reduces the exchange market pressure. A rise in the value of index reflects a stronger selling pressure on the domestic currency and vice-versa. One can measure the percentage change in the EMPI between two points in time and get a figure that indicates the amount by which EMPI pressure increased or decreased.

[3] In calculating percentage change in exchange rate we use the change from current exchange rate to previous exchange rate.

Threshold Level

Extreme positive values, generally measured in the mean and standard deviations of the index, can be used to define a crisis in the foreign exchange market. Eichengreen et al. (1995) applies a criterion of 1.5 standard deviations above the mean of the EMP index to define the threshold of a crisis in the exchange market by using the quarterly data of twenty industrial countries[4] from 1959 to 1993. Francis et al. (2003) adopts a less strict criterion and defines extreme values as those which have two standard deviations above the mean of the EMP index i.e., a currency crisis occurs when the index exceeds a threshold value of two standard deviations above its mean. Kaminsky and Reinhart (1999) catalog a crisis when index value exceeds three or more standard deviations above the mean value. In this study, we had followed the less strict criterion of Francis et al. (2003) i.e., two standard deviations above the mean of EMPI, because it explains most of the exchange market pressure in Pakistan. In our analysis, we have used the monthly data for the period of July 1995 to December 2008. The data requirement for the construction of the exchange market pressure index is as follows. The exchange rate of Pak rupee per US dollar[5], Pakistan international foreign exchange reserve at end month position and interest rate[6] of 6-months repo rate of treasury bills are used in the construction of EMPI and obtained from the different publication of SBP.

We have also estimated a behavioral equation to explore the possible determinants of changes in the exchange market pressure index in Pakistan. The model applied for this purpose is the following:

$$EMPI = \beta_0 + \beta_1 (INF)_t + \beta_2 (CAB)_t + \beta_3 (DD)_t + \varepsilon_t \qquad (2)$$

Where,

$EMPI_t$ = *Exchange Market Pressure Index*

INF = *Inflation rate*;

DD = *Domestic Credit, the share of Net domestic credit in monetary assets*

[4] These countries are USA, UK, Austria, Belgium, Denmark, France, Italy, Netherlands, Norway, Sweden, Switzerland, Canada, Japan, Finland, Greece, Ireland, Portugal, Spain, Australia and Germany.

[5] Monthly average of buying and selling of Rs/US$ is used in this study.

[6] In our analysis we have tried the different interest rates such as monthly weighted average of lending rate, 6-month treasury bills auction rate, 6-month repo rate, overnight rate and KIBOR rate. All these interest rates explained the same result.

CAB_t = Current account balance

δ = Error term

Inflation is expected to have a positive influence on the exchange market pressure index; higher inflation rate cuts the external demand of exportable goods, which in turn reduces export earnings and thereby raises the pressure in foreign exchange market. The current account balance, on the other hand is expected to have an inverse relationship with exchange market pressure index. A rise in the current account balance raises the foreign exchange earnings of the economy and puts a downward pressure in the foreign exchange market and vice versa. The domestic credit from banking system has expectedly a positive relationship with exchange market pressure index. Higher domestic credit increases the money supply in economy and reduces the value of domestic currency which in turn would put upward pressure in the foreign exchange market. Thus the expected signs of the parameters β_1, β_2 and β_3 are $(+,-,+)$ respectively.

As it is clear from the above description of the model, our study is different from a similar study on Pakistan by Khawaja (2007) in following terms:

- Khawaja (2007) excludes interest rate in computation of EMPI, while in this study we have used it in the calculations.
- Khawaja (2007) uses growth in domestic credit which was defined as the difference between total reserve money and the foreign component of the reserve money as explanatory variable. This is not the right definition of the domestic credit rather it is the net domestic assets of the central bank only. In our analysis, net domestic assets (NDA) of the banking system are used as independent variable. We have further divided the NDA into government sector borrowing and non-government sector borrowing and explored their combined as well as individual impact on EMPI.
- Growth in international inflation has been used as explanatory variable in Khwaja's (2007) study while in our investigation domestic inflation rate is used as independent variable.

4. Analyses of the key findings

The exchange market pressure index is shown in **Table 1** and **Figure 1**, which presents the descriptive statistics of the mean and standard deviations of the EMPI during five different periods. A number of important facts are worth highlighting here. **Table 1** indicates that EMPI (based on 6-month repo rate) was volatile during the period of FY96-98 on the back of the sizes of mean and standard deviation. This volatility was mainly due to the restriction of foreign assistance to Pakistan from different countries after the nuclear detonation in May 1998 and freezing of the foreign currency accounts in Pakistan. During the FY08-09 period, the sizes of the mean and standard deviations of EMP are again larger for 6-month repo rate.

Table 1: Exchange Market Pressure and Selected Statistics of Pakistan

	FY96-98	FY99-01	FY02-04	FY05-07	FY08-09	FY96-09
Total No. of months	36.0	36.0	36.0	36.0	18.0	162.0
Mean	1.2	0.0	-0.6	0.0	1.2	0.3
Standard deviation	2.7	3.1	1.0	0.4	2.4	2.2
Incidence rate* (percent)	27.8	19.4	2.8	0.0	33.3	14.8
Period Averages:						
CAB to GDP ratio	-4.5	-0.8	3.5	-3.4	-7.4	-2.5
Inflation rate	10.1	4.6	3.7	8.3	16.4	8.6
Real GDP growth rate	3.9	3.4	5.1	7.2	3.0	4.5
FB to GDP ratio	-5.9	-4.9	-3.4	-4.0	-6.4	-4.9
M2 to GDP ratio	44.2	38.8	42.1	45.7	42.4	42.6
No. of months in which EMPI (based on 6-months repo rate) was not within 2SDs of its mean	10.0	7.0	1.0	0.0	6.0	24.0
No. of times in which IMF help was sought due to crisis	3.0	2.0	0.0	0.0	1.0	6.0

***:** Incidence rate is the percentage of the number of signals over the total number of observations.

Figure 1: Trend of Exchange Market Pressure Index in Pakistan

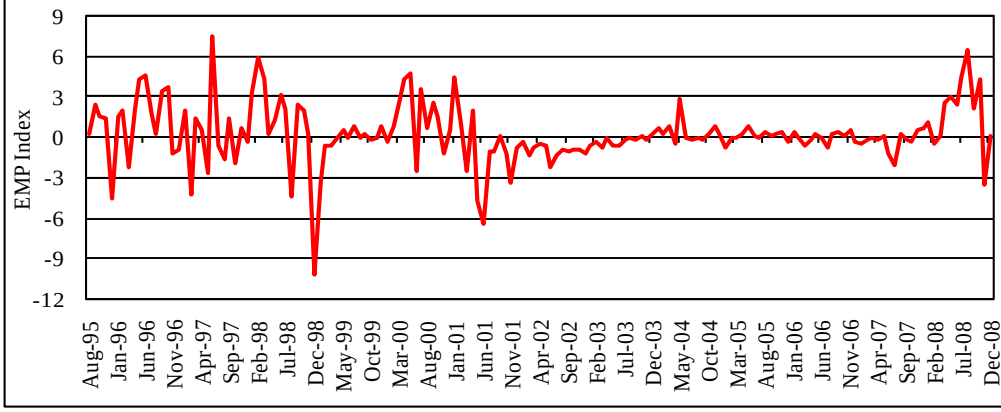
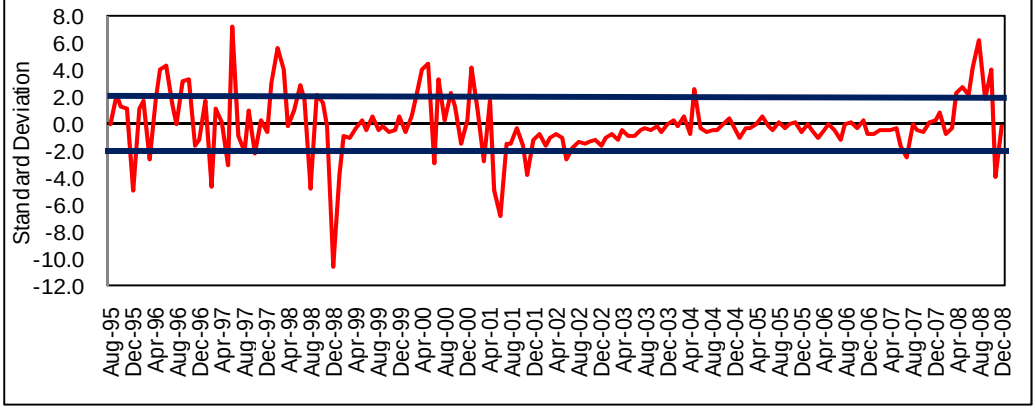


Table 1 also summarizes incidence rate of the exchange market pressure index and average of selected macroeconomic indicators for the reviewed period. Incidence rate is the percentage of the ratio of the number of signals over the total number of EMP observations (the total number of observations is 162). The signal represents the point when the value of EMPI is higher than 2 standard deviations from mean (**Figure 2**). The study period is divided into five segments; first four segments contain three years each (thirty six months) while the last part consists of eighteen months. During the study period of Jul-1995 to Dec-2008, twenty four signals have been identified by EMPI (see **Table 1**), which is about 15.4 percent of incidence rate. During this period, Pakistan had signed six different programs of total amount of SDRs 10,813.8 million with IMF for help, which consists of three Stand-By Arrangement (SBA) programs; two Poverty Reduction and Growth Facility (PRGF) programs; and one Extended

Figure 2: Deviation from Sample Mean



Fund Facility (EFF) program. A maximum of ten signals have been recognized in the period of FY96-FY98, which has 27.8 percent incidence rate. During this period, higher twin deficits (current account deficit and fiscal deficit), double digit inflation and relatively lower growth was observed in Pakistan economy. To overcome these problems, government of Pakistan approached IMF three times for an amount of SDRs 1,699.9 million. In the next segment (FY99-01), seven warnings have been identified by EMPI, which was followed by two financial assistance programs with IMF. Under these programs, Pakistan had received SDRs 1,326.4 million, which was 88.5 percent of the agreed amount.

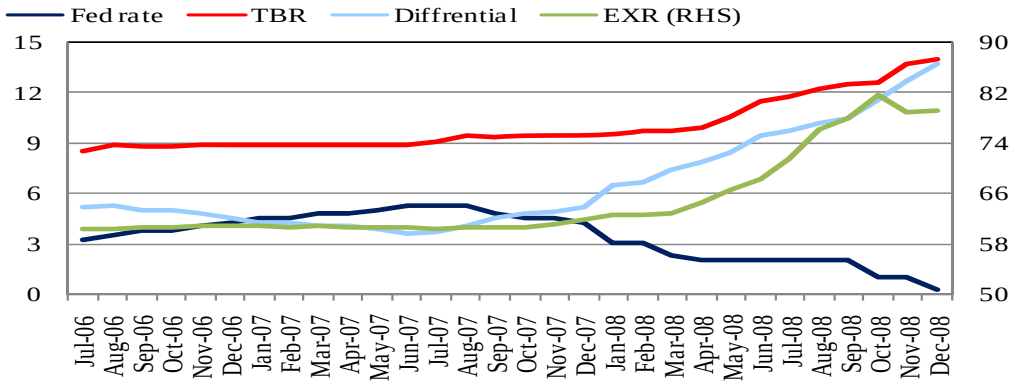
As far as FY08-09 is concerned, the highest 33.3 percent incidence rate was recorded, which shows the tremendous market pressure on Pakistani currency. Current account deficit, fiscal deficit, higher inflation, slower economic growth, and worsened law & order situation in the economy were the main factors for this pressure. Current account deficit represents the excess demand for foreign exchange, which puts a lot of pressure on the foreign exchange reserves and the exchange rate of the economy.

The SBP has intervened in forex market to stabilize the Pak rupee against different currencies, mainly in the form of oil import payments in forex market. During this period, the total SBP injection reached to US$ 20.6 billion and total mop-up reached to US$ 7.9 billion with net intervention of US$ 12.8 billion. Out of total injection, more than 75 percent support was for oil import payments. Despite such a huge intervention, Pak rupee depreciated by 23.6 percent against US$ in the time period of Jul-2007 to Dec-2008.

In this period (FY08-09), the SBP has maintained the tight monetary policy to keep the interest rate at higher level while loose monetary policy was observed in USA in the shape of decline in the fed target rate. The movement of interest rate in different directions has widened the interest rate gap or differential, which potentially attracts the inflow of foreign exchange and stabilize the exchange rate. But practically, this link did not work in Pakistan economy due to global financial crisis and macroeconomic imbalances in Pakistan (**see Figure 3**). Before October 2007, Pakistan has maintained the interest rate differential between 6-month repo rate and fed-rate. After this period, despite rising interest rate differential, Pak rupee depreciated significantly and reserve level declined considerably which shows the

pressure in the forex market. To control these pressures, the government of Pakistan has signed 23-month SBA program with IMF in November 2008.

Figure 3: Interest Rate Differential and Exchange Rate



In contrast to FY08-09 period, two segments (FY02-04 and FY05-07) registered very small (1.4 percent) incidence rate (only one signal was received from exchange market pressure index) during this period. During the three years (FY02-04), current account balance as percent of GDP of Pakistan was in surplus with an average of 3.8 percent, and inflation was relatively lower. After a long period, May 2004 was the month in which a single signal observed on the back of change of current account balance from surplus account to deficit account.

After having discussed the EMPI in forex market in different segments, now we analyze the determinants of EMPI. The connection between current account balance and EMPI is confirmed by the Granger causality test in which we reject the null hypothesis of CAB does not Granger Cause the EMPI, EMPI(+1) (one period lead) and EMPI(+2) (two period lead) (See **Table 2**). The CAB not only affects the current EMPI but also has the influence on the EMPI of the next two periods.

Similar to current account balance, inflation rate also affects EMPI which is verified by rejecting the null hypothesis of the Granger causality test, according to which inflation does not cause the EMPI (**see Table 2**). EMPI is not only affected by the current inflation rate but is also affected by the inflation of the last two periods.

Table 2: Results of Granger Causality Test

Null Hypothesis	Observation	F-Statistic	Probability
CABGDP does not Granger Cause EMPI	110	5.958	0.004
EMPI does not Granger Cause CABGDP		1.464	0.236
EMPI(+1) does not Granger Cause CABGDP	109	1.199	0.306
CABGDP does not Granger Cause EMPI(+1)		14.179	0.000
EMPI(+2) does not Granger Cause CABGDP	108	0.433	0.650
CABGDP does not Granger Cause EMPI(+2)		11.447	0.000
EMPI(+3) does not Granger Cause CABGDP	107	1.309	0.275
CABGDP does not Granger Cause EMPI(+3)		1.641	0.199
EMPI does not Granger Cause INF	110	0.357	0.701
INF does not Granger Cause EMPI		2.990	0.055
EMPI(+1) does not Granger Cause INF	109	0.074	0.929
INF does not Granger Cause EMPI(+1)		5.456	0.006
EMPI(+2) does not Granger Cause INF	108	0.152	0.859
INF does not Granger Cause EMPI(+2)		8.143	0.001
EMPI(+3) does not Granger Cause INF	107	0.930	0.398
INF does not Granger Cause EMPI(+3)		6.687	0.002
EMPI does not Granger Cause GBBM2	110	2.198	0.116
GSBM2 does not Granger Cause EMPI		0.001	0.999

CABGDP: current account balance to GDP ratio, INF: inflation rate, GSBM2: government sector borrowing to M2 ratio, EMPI: exchange market pressure index, EMPI(+1): exchange market pressure index one period lead, EMPI(+2): exchange market pressure index two period lead, EMPI(+3): exchange market pressure index three period lead,

Regression Analysis

The results of regression equation have been presented in **Table 3**. It is found that inflation, current account balance and domestic credit measured by net domestic assets of the banking system have significant impact on exchange market pressure index with expected signs. The value of coefficient of inflation is 0.38, which is statistically significant. The EMPI is also affected by the inflation of the last period. The coefficient of inflation with one period lag is also statistically significant as given in the Table 3. The current account balance of both current and one period lag have significant negative impact on EMPI as shown by their corresponding coefficients of -0.12 and 0.11. On the other hand, the domestic credit variable has also expected positive sign and statistically significant coefficient of 0.02.

We have repeated the estimation exercise with bifurcation of the domestic credit into its components of government sector borrowing and non-government borrowing. While the coefficients of inflation and current account balance remained fairly robust with almost same

values in the second version of the model, it is interesting to note that only one component of the domestic credit, i.e. government credit came out as a significant factor affecting EMPI (see Table 4). The non-government credit has no influence on the EMPI. The policy implications are very clear that the government sector borrowing should be restrained in order to check exchange market pressure.

Table 3: Regression Estimation of Exchange Market Pressure Index (EMPI)

Dependent Variable: EMPI; Method: Least Squares; Number of Observations: 111				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.272	1.259	-1.804	0.074
INF	0.382	0.152	2.522	0.013
CAB	-0.123	0.031	-3.987	0.000
INF(-1)	-0.308	0.154	-1.998	0.048
CAB(-1)	0.109	0.033	3.319	0.001
EMPI(-1)	0.301	0.090	3.328	0.001
DD	0.020	0.014	1.442	0.152
R-squared	0.389	S.D. dependent var		1.833
Adjusted R-squared	0.353	Akaike info criterion		3.675
S.E. of regression	1.474	Schwarz criterion		3.846
Log likelihood	-196.986	F-statistic		11.015
Durbin-Watson stat	2.023	Prob(F-statistic		0.000

Table 4: Regression Estimation of Exchange Market Pressure Index (EMPI)

Dependent Variable: EMPI; Method: Least Squares; Number of Observations: 111				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.166	2.462	-0.880	0.381
INF	0.381	0.153	2.481	0.015
CAB	-0.125	0.037	-3.359	0.001
INF(-1)	-0.308	0.157	-1.966	0.052
CAB(-1)	0.105	0.041	2.539	0.013
EMPI(-1)	0.286	0.094	3.040	0.003
GSB	0.030	0.021	1.471	0.144
NGSB	0.011	0.045	0.241	0.810
R-squared	0.393	S.D. dependent var		1.833
Adjusted R-squared	0.352	Akaike info criterion		3.686
S.E. of regression	1.476	Schwarz criterion		3.881
Log likelihood	-196.583	F-statistic		9.525
Durbin-Watson stat	2.010	Prob(F-statistic)		0.000

Given that the non-government credit found insignificant, in another variant, we have included only government sector credit in the model and re-estimated it again and found almost the same results which indicates the robustness of the model (see **Table-5**).

Table 5: Regression Estimation of Exchange Market Pressure Index (EMPI)

Dependent Variable: EMPI; Method: Least Squares; Number of Observations: 111				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.598	0.716	-2.233	0.028
INF	0.375	0.151	2.485	0.015
CAB	-0.130	0.031	-4.174	0.000
INF(-1)	-0.301	0.153	-1.964	0.052
CAB(-1)	0.099	0.034	2.942	0.004
EMPI(-1)	0.282	0.092	3.056	0.003
GSBM2	0.032	0.019	1.671	0.098
R-squared	0.393	S.D. dependent var		1.833
Adjusted R-squared	0.358	Akaike info criterion		3.669
S.E. of regression	1.470	Schwarz criterion		3.840
Log likelihood	-196.614	F-statistic		11.205
Durbin-Watson stat	2.008	Prob(F-statistic)		0.000

5. Conclusion

The paper constructs an exchange market pressure index for Pakistan over the sample period of July-1995 to December-2008 by using the exchange rate, international reserve and interest rate. The index was applied to define a threshold level i.e., two standard deviations above the mean of EMPI. During the study period, twenty four signals have been identified with 15.4 percent of incidence rate, which is defined as the percentage of the ratio of the number of signals over the total number of EMPI observations. A maximum of ten signals have been recognized in the period of FY96-FY98, which has 27.8 percent incidence rate. A highest 33.3 percent incidence rate was recorded in the period of FY08-09, which shows the tremendous market pressure on Pakistani currency during that period. Contrary to the period of FY08-09, the lowest incidence rate and thus lowest number of signals was seen in the period of FY02-04 and FY05-07.

A Granger casualty analysis shows that current account deficit and inflation cause the EMPI contemporaneously as well as with one month lag. As far as the OLS results are concerned, almost same results are drawn from regression. A precise relationship between EMPI and other variables such as inflation, current account balance and domestic credit has been investigated by using ordinary least squares technique. It was found that inflation and government sector credit positively affect the exchange rate market pressure index while current account balance has a negative impact on the EMPI.

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