

# **Reconsidering Exchange Market Pressure Index in Pakistan**

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## **Introduction**

Pakistan's economy is prone to external shocks and, like most developing economies, has little capacity to absorb such shocks. Due to weak economic structure and a highly sensitive foreign exchange market, it has repeatedly faced severe pressures on the domestic currency. Any prolonged phase of pressures on domestic currency can have serious consequences for the economy. To avoid any crisis situation, it is important for policy makers to know the timings of such pressure and its intensity so that they can investigate the underlying economic fundamentals and react proactively. Measurement of such pressures is much easier for the economies pursuing perfectly floating exchange rate regimes, because in such economies changes in exchange rate fully reflect the underlying pressures on the domestic currency.

Since the breakdown of the Bretton Woods fixed exchange rate system, only few countries have adopted a perfectly floating exchange rate regime in practice. Monetary authorities of most countries intervene in the foreign exchange markets to avoid undesirable volatility. In such cases, changes in exchange rate only captures the crises and speculative attacks which turn out to be successful.<sup>2</sup> In case of Pakistan, from time to time State Bank of Pakistan (SBP) has partially or fully warded off exchange rate pressures through policy measures, either through indirect interventions via changes in interest rates and other policies or through direct interventions via intervening in the foreign exchange market. Therefore the exchange rate change alone is not an accurate measure of underlying pressures on PKR. To gauge accurate level of the underlying pressures on the domestic currency for economies pursuing managed float exchange rate system, literature provides the measure of Exchange Market Pressure (EMP).

EMP refers to the magnitude of money market disequilibrium arising from international excess demand or supply of the domestic currency. Due to interventions by central banks in the exchange rate market, actual exchange rate movements do not fully reflect the extent of

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<sup>2</sup> Exchange rate movements will not capture the unsuccessful part of speculative attacks which is warded off through policy measures.

foreign exchange market pressures. EMP, in the form of an index captures the impact of both the exchange rate changes and direct and indirect interventions of the central bank.<sup>3</sup> Although exchange rate movements and magnitude of direct interventions are known to the central banks, and it may lead to an argument that EMP is of no use for central banks. However, the actual impact of indirect interventions, through behavioral changes of different segments of the economy, remains unknown to the central banks in the absence of EMP. Moreover, known future paths of EMP as compared to forecasts of exchange rate, provides more comprehensive policy tradeoffs expected to be faced by the central banks in future.

EMP measurement has remained an important part of the empirical literature on speculative attacks and currency crises. Over the past four decades, a considerable volume of economic literature has been devoted for identification and computation of EMP. It can be classified into two strands, namely model-dependent and model-independent approaches. Model-dependent approach uses a stochastic macro model for either deriving the components of EMP or weights assigned to them [Girton and Roper (1977), Roper and Turnovsky (1980) and Weymark (1995)]. The second strand of studies does not use a macro model for deriving the components of EMP or weights assigned to them [Eichengreen et al (1996), Kaminsky and Reinhart (1999) and Pontines and Siregar (2007)]. Believers of first strand argued that the magnitude of interest rate and foreign exchange reserve changes are determined by the structure of the economy and central bank intervention activity, rather than a volatility-smoothing technique that ensures the components of EMP are equally weighted. Therefore, it is necessary that exchange market pressure indices must be derived from a model that reflects the economy for their proper interpretation.

Although there is considerable literature on construction and analysis of EMP for many developed and developing countries, there is hardly any study for Pakistan with the exceptions of Khawaja (2007), Khan (2010) and Haider (2011). All of these studies use change in reserves to proxy the intervention by the central bank in the exchange market. While the literature suggests that change in reserves can only be used as a proxy of interventions only if the interventions are the sole causative factor for change in reserves. In the presence of other causative factors, use of change in reserves instead of interventions may provide the misleading results about the underlying pressures. Moreover, all of these studies have assumed that money demand function and other structural relationships in the economy are stable, which may not necessarily be the case. In the case of unstable relations, EMPs calculated for Pakistan in the literatures may not be a true representative of underlying pressures in the economy.

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<sup>3</sup> Direct intervention means central bank selling or purchasing, doesn't include swaps, foreign exchange reserves to stabilize the exchange rate whereas indirect intervention stands for policy measures like capital controls and interest rate changes.

As the earlier work for Pakistan has already settled, up to some extent, the debate on importance and utilization of EMP, the motivation of this note is to highlight some important technical aspects in the construction of EMP. By relying on model dependent approaches, this note attempted to analyze whether or not the use of change in reserves or data on interventions in the foreign exchange market by SBP makes any difference in the construction of EMP. Moreover, this note also tested how EMP could change under the validity and invalidity of the assumption of stable relations. In addition, this note also provides an intervention index which measures the extent of pressure waded off by the central bank on monthly basis from July 2004 to December 2012. Section 2 comprises of theoretical underpinnings of the models used in this note. Section 3 provides the debate of using intervention data instead of change in reserve. Section 4 evaluates effects of the stability of relationships assumption on EMP. Section 5 provides interventions index for Pakistan. And section 6 concludes the debate.

### Theoretical Underpinning of the Models

In this note we have used model dependent approaches to measure the EMP for Pakistan. Roper and Turnovsky (1980) and Weymark (1995) have been taken as the representatives of model dependent approaches. It is pertinent to note here that these models are the same which have been used by earlier studies for Pakistan. The only difference is the use of actual intervention data instead of change in reserves data and selection of time varying parameter approaches.

#### Roper and Turnovsky (1980)

Roper and Turnovsky (1980) used IS-LM stochastic framework to gauge the exchange market pressures in the economy. They derived the optimum trade-off that monetary authorities face between foreign exchange reserve and exchange rate changes for stabilizing domestic output in a stochastic IS-LM framework that includes a foreign sector. The stochastic IS-LM framework used by them is as follows:

$$y_t = b_1 y_t - b_2 i_t + b_3 s_t + u_{1t} \quad (1)$$

$$m_t = a_1 y_t - a_2 i_t + u_{2t} \quad (2)$$

$$i_t = i_t^* + E_t i \Delta s_{t+1} \quad (3)$$

$$E_t i \Delta s_{t+1} = \theta (\bar{s} - s_t) \quad 0 \leq \theta \leq 1 \quad (4)$$

(1)(2)(3)(4) Where  $y_t$  is domestic output,  $i_t$  is domestic interest rates,  $s_t$  is exchange rate level denoting the number of units of domestic currency per unit of foreign currency,  $\bar{s}$  is equilibrium exchange rate level,  $s_{t+1}$  is expected exchange rate level in the next period,

$m_t$  is money stock and  $u_{1t}, u_{2t}$  are stochastic disturbances. By using the aforementioned framework, Roper and Turnovsky (1980) defined the EMP as:

$$EMP_t = \Delta s_t + \eta \Delta res_t$$

Where  $\eta$  is the interaction coefficient and defined as

$$\eta = - \frac{(1 - b_1)}{a_1(b_3 + b_2\theta) + a_2\theta}$$

Contrary to model-independent approaches which assign equal weight to exchange rate, interest rate and foreign exchange reserve changes, Roper and Turnovsky's approach requires estimating six parameters from the IS-LM framework, as outlined above, for assigning weight to foreign exchange reserve component of Exchange Market Pressure.

### **Weymark (1995)**

Roper and Turnovsky (1980) used stochastic IS-LM framework for deriving weights to the components of exchange market pressure index. However, they did not show what fraction of pressure Central Bank relieves through the purchase and sale of foreign exchange reserves. Weymark (1995) addressed this issue by constructing an intervention index that shows what fraction of pressure Central Bank relieves through the purchase and sale of foreign exchange reserve. Weymark (1995) developed a small, open economy model of Exchange Market Pressure. This consists of money demand, price equation, uncovered interest rate parity, money supply process and monetary authority response function to exchange rate fluctuations. The framework used by Weymark (1995) is as follows:

$$m_t^d = b_1 y_t - b_2 i_t + u_{1t} \quad (5)$$

$$p_t = a_0 + a_1 p_t^* + a_2 s_t + u_{2t} \quad (6)$$

$$i_t = i^* + E_t s_{t+1} - s_t \quad (7)$$

$$m_t^s = m_{t-1}^s + \Delta d_t + \Delta f_t \quad (8)$$

$$\Delta f_t = -\bar{\rho}_t \Delta s_t \quad (9)$$

(5) (6) (7) (8) (9) Where  $m_t$  is money stock,  $p_t$  is domestic price level,  $y_t$  is real domestic income,  $i_t$  is domestic interest rates,  $s_t$  is exchange rate level denoting the number

of units of domestic currency per unit of foreign currency,  $\Delta d_t$  is change in domestic credit,  $\Delta f_t$  is change in foreign exchange reserves,  $\rho_t$  is the monetary authority's time variant response coefficient and  $u_{1t}$ ,  $u_{2t}$  are stochastic disturbances. By using the aforementioned framework, Weymark (1995) defined the EMP as:

$$EMP_t = \Delta s_t + \eta \Delta res_t$$

Where  $\eta$  is the interaction coefficient and defined as:

$$\eta = \frac{-1}{a_2 + b_2}$$

Roper and Turnovsky approach requires estimating six parameters from the IS-LM framework, whereas for construction of EMP through Weymark approach requires only two stochastic equations to be solved. Which one of these two approaches is better for Pakistan is an empirical question which needs to be addressed in future research.

### **Should we use change in reserves as proxy of Interventions?**

A country adjusts to international shocks through four potential paths: change in the exchange rate, intervention by the central bank, raising or lowering the interest rate in an attempt at influencing the exchange rate and modifying capital controls. For many decades, economists have grappled with the problem of measuring EMP: a mechanism for reducing these four numbers into a single measure. The whole idea of EMP revolves around the actual exchange rate changes and the potential changes warded off by the central bank through direct or indirect interventions. Most of the empirical work around the world used changes in reserves as a proxy of direct interventions of the central bank. But recently, Patnaik and Shah (2011) have come up with the conclusions that changes in reserves is a poor proxy for actual reserves exhausted to either influence the path of exchange rate or avoid unnecessary volatility. They argued that changes in reserves could only be used as proxy for the economies where market intervention of central bank is the sole causative factor of changes in reserves.

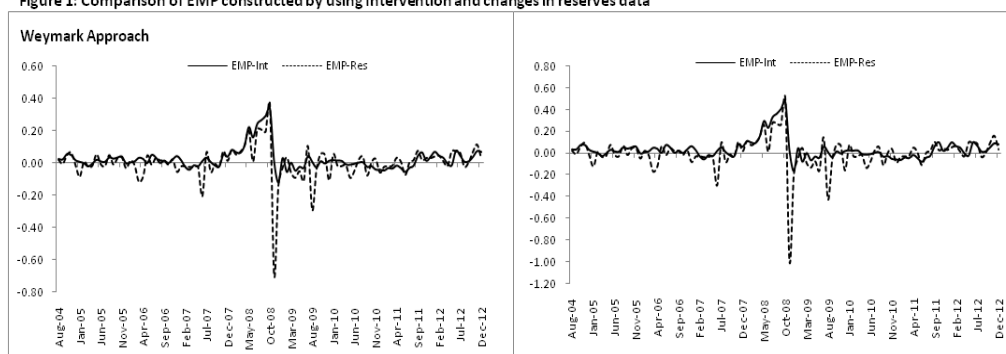
All the work already done for Pakistan has been carried out by using the changes in reserves as the proxy of SBP's direct intervention. For Pakistan, interventions by SBP are not the sole causative factor of changes in reserves. Moreover, correlation amongst the changes in reserves and SBP's market intervention is low, specifically 0.5 percent. Such a low correlation is the main motivation to study this topic in detail for Pakistan. I have compared

the EMP constructed for Pakistan by using both changes in reserves and actual intervention data. Results confirm the hypothesis that changes in reserves is a poor proxy for actual

market intervention. EMP constructed by using change in reserves doesn't provide the actual level of underlying pressures and under some unique economic conditions even could provide entirely contradictory results.

**Figure 1** presents the EMP indices constructed by using both actual intervention and changes in reserves data by following both the model dependent approaches.<sup>4</sup> Both approaches confirm that EMP indices constructed by using actual intervention data have relatively low volatility compared to the ones based on changes in reserves data.

Figure 1: Comparison of EMP constructed by using Intervention and changes in reserves data



Circled points in the graph validate the hypothesis that EMPs constructed by using changes in reserves data instead of interventions data provides contradictory results. EMP-reserves indicate that at the circled periods there were pressures of appreciation which central bank waded off by purchasing the foreign exchange. For instance, in November 2008, reserves increased by 2.4 billion which is reflected in high level of appreciation pressures in the graph. But at the same time, State Bank was still selling the foreign exchange to the market which means there were no pressures of appreciation. By looking at the graphs, it is advisable to use interventions data to gauge the underlying exchange market pressures.

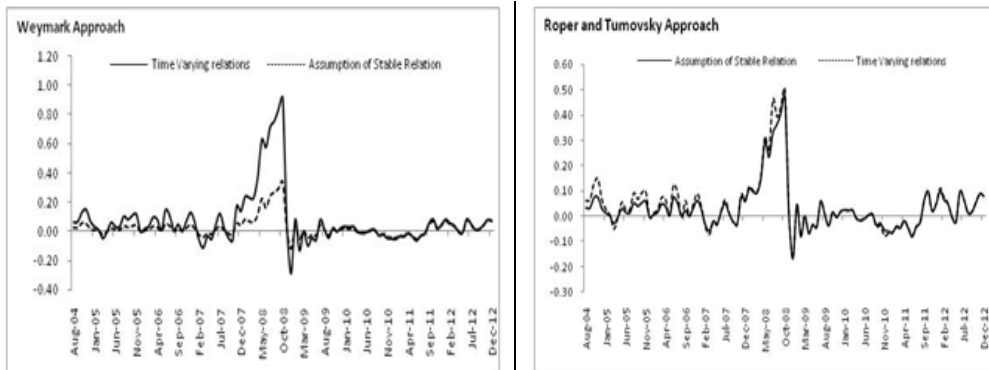
### Stability of relationships for developing economies

Studies already conducted for Pakistan have implicitly assumed stable economic relations and used a fixed parameter approach for constructing exchange market pressure index. However, a fixed parameter approach in the face of structural instability is considered as one of the most important factors for the poor performance of exchange rate models. Lucas

<sup>4</sup> Results are based on co-integrating relations. The relations were solved by using Johansen and Engel-Granger co-integrating techniques.

(1976), Meese and Rogoff (1983) and Wolf (1987) consider changes in policy regime, unstable money demand functions, changes in global trade patterns and productivity differential as the important factors for the out-of-sample poor performance of exchange rate models. Frenkel (1981) particularly attributes the 1970s collapse of purchasing power parity for France, Germany, UK and US to the volatile nature of the decade that resulted from real shocks, supply shocks, commodity booms and shortages, shifts in the demand for money, differential productivity growth and the uncertain future course of political and economic events which induced sharp and frequent changes in expectations. Therefore, it seems important that when estimating real money demand and price equation we take account of the potential time-varying nature of estimated parameters. Work already done for Pakistan has implicitly assumed that behavioral relationships are stable, which may not be true.

Figure 2: Comparison of EMP constructed by using Time varying relations and Assuming relations are stable



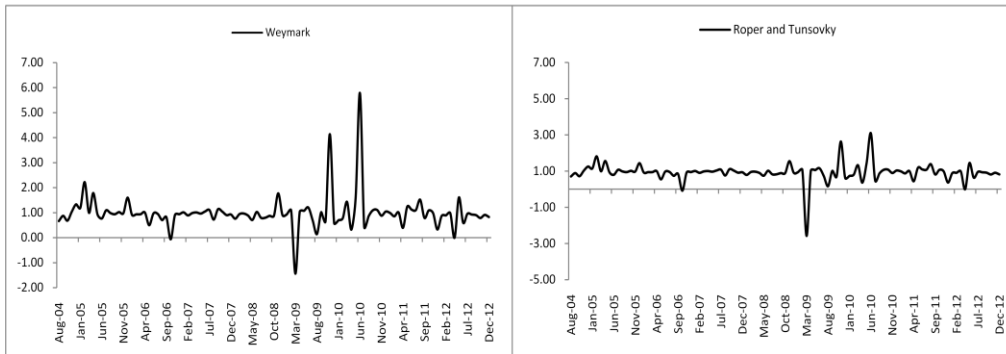
To overcome this shortcoming of earlier work on Pakistan, in this note we have introduced the concept of time varying interaction coefficient, by using a fixed and flexible window. Time varying parameters incorporate the structural changes faced by the economy in the sample period. **Figure 2** presents the comparison of EMPs constructed with the scenarios of stable and unstable economic relations. Assumption of stable relations seems to be unrealistic in the case of Pakistan. And the same is confirmed by the graphs, especially for the crisis period. By looking at the graphs, we can conclude that different economic relations change significantly in the crisis period and also just before the triggering of crisis. This reinforces the importance of EMP for central banks.

## Intervention Index for Pakistan

Central bank's intervention index, composite intervention index including both direct and indirect interventions, remained the missing element in all the previous research conducted for Pakistan. One may argue that what kind of intervention index this will be which is being constructed from EMP is already based on interventions data. In this backdrop, for clarification it is pertinent to note that intervention data only pertains to direct intervention of SBP in the foreign exchange market and do not include the impact of indirect interventions. Whereas intervention index include both direct and indirect interventions made by SBP to ward off the exchange pressures. Intervention index measures the fraction of total pressure on the currency that Central Bank relieves. Hence, the intervention index is the ratio of reserve changes to pressure, adjusted for parameter ( $\eta$ ). When monetary authorities engage in exchange market intervention, the intervention index will be:

$$\omega_t = \frac{\eta \Delta res_t}{\Delta s_t + \eta \Delta res_t}$$

Figure 3: Intervention Index of State Bank of Pakistan



In this note, intervention index for State bank of Pakistan for the last 8 years by using Weymark and Roper and Turnovsky has been constructed and presented in **figure 3**. Value of Intervention index ranges between  $-\infty < \omega < \infty$ . Intervention index equal to zero indicates that the central bank abstained from intervention. Intervention index equal to one indicates that exchange rate remain fixed. Value between zero and one implies that central bank is pursuing a managed float exchange rate regime. Value less than zero shows the Central Bank's leaning with the wind policy. This can be interpreted that the Central Bank purchased foreign exchange reserves when there was a downward pressure on domestic currency. Values greater than one indicate that the Central Bank's response was more than that warranted by the pressure. This leads the exchange rate to move in the direction



opposite to that warranted by the pressure. **Figure 3** reveals that most of the time, since August 2004, response of State Bank of Pakistan remained more than what was required at that time. And there are some short episodes where State bank of Pakistan adopted the policy of leaning with the wind.

## **Conclusion**

Pakistan is one of the countries pursuing managed float regime for exchange rate so that movements of exchange rate do not reflect the actual pressures on domestic currency. Objective of this policy note was to construct a technically refined exchange market pressure index for Pakistan. Although there are certain studies that have already constructed the index for Pakistan, they all suffer from some technical weaknesses.

This note has three main contributions to the literature on EMP for Pakistan. First, contribution is the identification of weaknesses that EMPs based on changes in reserves data suffer. This note has empirically shown that EMPs based on changes in reserves provides misleading results. Secondly, contribution is the debate about stable or unstable economic relations. All the previous work for Pakistan has implicitly assumed stable economic relationships, which is too strong an assumption to be taken for Pakistan. This note has provided the comparisons of stable and unstable relationships and argued that the time varying parameters provide more realistic results. Thirdly, contribution is the construction of intervention index of State Bank of Pakistan and evaluation of policies at different periods. Although this note has tried to cover most of the angles involved in EMP construction, yet there are questions like what determines the dynamics of exchange market pressure and how EMP construction is effected by using different econometric techniques remained unattended.

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